All-Alaska Rate Electric Power Pricing Structure

Ginny Fay and Alejandra Villalobos Meléndez

Technical Report

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Submitted and Prepared by:

Ginny Fay and Alejandra Villalobos Meléndez
Institute of Social and Economic Research
University of Alaska Anchorage
3211 Providence Dr
Anchorage AK 99508
For information contact:
vfay@alaska.edu
907-786-5402

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Executive Summary

Economists at the Institute of Social and Economic Research, University of Alaska Anchorage were asked to research the potential options and impacts of establishing an All-Alaska Rate as an alternative to the current Power Cost Equalization (PCE) program funding formula. We were asked to provide a history of the PCE program and information on electricity rates and patterns of consumption across regions of Alaska. This report provides the results of this analysis.

Alaska is unique in many ways, including its consumption and pricing of electricity. There are large regional differences in consumption and prices that result from proximity to different types and quantities of resources. Differences in remoteness and population size also influence costs. Urban areas in the southern Railbelt benefit from larger economies of scale and access to natural gas and hydroelectric resources; the majority of hydroelectric facilities are located in Southcentral and Southeast Alaska. Most communities in rural Alaska depend on volatile and high price fossil fuels for the generation of electricity.

The Alaska statewide weighted average residential rate for electricity (17.6 cents per kilowatt (kWh) in CY2011) is higher than the U.S. average of 11.8 cents per kWh (U.S. EIA, 2012). Alaska now trails behind Hawaii (34.5 cents), New York (18.4 cents) and Connecticut (18.1 cents) based on ranking of average residential price per kWh. Hidden in the Alaska statewide average is considerable variation with some communities paying less than the national average and some paying considerably more.

The Railbelt and Southeast regions have the lowest average residential rates. North Slope residential customers also have lower average rates. Some communities in the North Slope region have access to more affordable natural gas and the North Slope Borough provides energy payments in addition to Power Cost Equalization (PCE) disbursements. Most other regions have rates (adjusted for PCE) almost twice that of Alaska urban areas. Some communities with hydroelectric power have the lowest rates but in most cases customers are not paying the full, true cost of power because the cost of construction was heavily subsidized by state and federal governments. Table S1 shows average annual residential consumption and rates across different regions of Alaska.

Table S1. Average Annual Residential Consumption and Rates, 2008-2010

	kWh per Customer			Before PCE			After PCE		
AEA Region	2008	2009	2010	2008	2009	2010	2008	2009	2010
Aleutians	4,776	4,788	5,014	0.48	0.40	0.44	0.22	0.21	0.21
Bering Straits	4,569	4,751	4,524	0.41	0.47	0.44	0.16	0.20	0.21
Bristol Bay	4,219	3,910	4,131	0.43	0.50	0.47	0.17	0.21	0.28
Copper River/Chugach	4,054	4,297	4,331	0.28	0.25	0.26	0.18	0.19	0.18
Kodiak	4,380	4,779	5,145	0.20	0.17	0.18	0.12	0.13	0.16
Lower Yukon-Kuskokwim	4,157	4,262	4,333	0.52	0.58	0.52	0.19	0.22	0.24
North Slope	5,918	7,480	8,230	0.14	0.14	0.13	0.11	0.13	0.12
Northwest Arctic	5,537	5,755	5,860	0.48	0.56	0.51	0.21	0.20	0.21

Railbelt	8,080	7,897	7,514	0.16	0.16	0.15	0.16	0.16	0.15
Southeast (Non PCE)	11,412	12,244	11,733	0.11	0.10	0.10	0.11	0.10	0.10
Southeast (PCE)	4,545	4,460	4,290	0.43	0.38	0.41	0.18	0.19	0.19
Yukon-Koyukuk/ Upper Tanana	3,191	3,348	3,322	0.53	0.52	0.52	0.20	0.22	0.23

Source: Alaska Energy Statistics 1960-2010, (2011).

Power Cost Equalization Program

The Power Cost Equalization is a program that helps reduce electricity rates that residential customers and community facilities pay. The PCE program has two predecessors between fiscal year (FY) 1981 and FY1985, the Power Production Cost Assistance program and the Power Cost Assistance program. The PCE program was created in 1984 when the Legislature enacted Alaska Statutes 44.83.162-165 replacing the Power Cost Assistance program. The program became effective in October 20, 1984 (FY 1985) and was funded through appropriations from the general fund of approximately $6.67 million (2010$$). The

Table S2. Timing and characteristics of implemented power cost assistance programs

	PPCA (FY 1981)	PCA (FY 1982-1985)	PCE (FY 1985)	PCE (FY2000)	PCE (FY 2011)
Base rate (2010 cents/kWh)	18.4	24.3	17.2	15.2	14.0
Ceiling rate (2010 cents/kWh)	96.0	91.2	106.4	66.5	100.0
Eligible costs for reimbursement	85%	95%	95%	95%	95%
Eligible costs for reimbursement over ceiling	Yes, 100%	No	No	No	No
Consumption Limits – Community Facilities[b] kWh/month	None	55 kWh per Resident	70 kWh per Resident	70 kWh per Resident	70 kWh per Resident
Residential & Commercial Consumption Limits kWh/month –	N/A	600	750[c]	500 Commercial no longer eligible	500 Commercial no longer eligible
Eligible cost categories for reimbursement	only generation and transmission	generation, transmission, distribution and administrative			

Source: Modified table "Comparison of PPCA, PCA, PCE and PCE-REC" (Brooks, 1995)

[b] Community facilities is defined as water and sewer facilities, charitable educational facilities, public lighting, or community buildings whose operations are not paid by the state, federal government or private commercial party.

[c] Starting in 1993, the PCE eligible kWh per month limit dropped to 700.

PCE program has had only a few modifications over its almost 26 year life. Table 3 describes the differences across the programs, which in their basic structure and funding formulas are quite similar. In 2010, there were 190 communities that were eligible and participated in the PCE program.

The responsibilities of administering the PCE program are divided between the Regulatory Commission of Alaska (RCA)[1] that evaluates utility eligibility and costs per kilowatt-hour (PCE level), and the Alaska Energy Authority (AEA)[2] that determines the number of eligible kilowatt-hours in order to calculate the appropriate payment and make the disbursement.

A utility's PCE payment per kWh is determined by a formula that covers 95% of a utility's cost between a floor or base rate (average of rates in Anchorage, Fairbanks and Juneau, 13.42 cents/kWh; the base rate is revised every year by RCA) and a ceiling (currently $1.00) for a defined level of consumption (500 kWh for residential customers, and 70 kWh per month multiplied by the community's population for public facilities). The PCE rate is re-calculated for eligible utilities once a year by RCA. The PCE formula also factors in minimum generation efficiency and maximum line loss standards. State and Federal customers, as well as commercial customers, are not eligible for the PCE credit.

Seven years after the PCE program was established, funding the program became a challenge as world oil prices sharply decreased lowering State revenues. Since inception, the program was not fully funded by the Legislature in 15 out of 25 fiscal years. However, per capita electricity consumption continued to steadily rise in the years of pro-rated funding.

Across PCE communities there are significant differences in remoteness, population sizes (ranging from 8 to about 6,000 people), available means for transporting and storing fuel, income and other factors that ultimately affect electricity prices.[3] Hence, there is a large variability in electricity rates across PCE communities, which in turn, affect their levels of electricity consumption.

Nonetheless, on average, PCE residential customers consume significantly less (over 40% less) electricity per month than customers in urban areas of Alaska. Average annual per customer residential consumption in most Alaska regions is between 4,000 and 6,000 kWh per year or 333 and 500 kWh per month. The Yukon-Koyukuk/Upper Tanana region has the lowest at just over 3,000 kWh per year or 250 kWh per month. In the Railbelt average annual consumption in Fairbanks is 8,285 kWh and Anchorage is 7,475 kWh or 690 kWh and 623 kWh per month, respectively. In Anchorage many household appliances such as hot water heaters and clothes driers operate on natural gas rather than electricity, as is the case in rural Alaska.

In most PCE communities average consumption per customer per month is below the 500 kWh PCE eligibility cap. During summer months in 2009, less than 18% of eligible communities had average consumption levels above the PCE cap. Most of the communities where average monthly consumption

[1] Previously Alaska Public Utilities Commission, APUC.
[2] Originally APA, Alaska Power Authority
[3] Appendix F lists PCE communities and their residential and effective rates, average consumption per residential customer per month, population, average household size (2004), average real median income (2004) and average fuel prices in 2009.

exceeded the 500 kWh cap were communities that have effective electric rates comparable to those in urban areas (e.g. North Slope[4]), have comparatively high incomes, and/or are located in Southeast or Southwest Alaska. Even during winter, about 60% of the PCE communities did not have average consumption above 500 kWh per month per residential customer. On average consumers that increase their levels of consumption by more than 10% during the winter months are those in communities where the effective rates[5] are below 30 cents per kWh.

The average PCE utility generates less than 3,000 MWh per year; about 30% of the utilities generate less than 500 MWh and the smallest generate less than 30,000 kWh per year. By comparison, urban utilities (Anchorage and Fairbanks) generate over 1 million MWh per year. This means urban utilities produce over 300 times as much power as the average PCE utility. This large difference in demand is an important reason why one of the biggest challenge in providing electricity (and other public services) to rural residents lies in the lack of economies of scale; this intractable problem is difficult to overcome. The fixed costs associated with running a utility are large and if the number of customers and/or levels of consumption are very small these costs must be spread out over few customers and kilowatt-hours.

Despite this challenge, the PCE program is fairly effective at lowering the effective residential rates for the communities served. Communities with higher rates receive more relief, while regions with lower rates, such as the North Slope, receive lower levels of assistance.

All-Alaska Rate

Most electric power generation in Alaska is subsidized; what vary are the extent and the mechanisms. Some subsidies are more transparent such as the Power Cost Equalization program. Others are less visible such as energy project financing that writes down construction debt. In addition to economies of scale and rural remoteness, some of the variability in electric rates is a reflection of the luck of proximity to resources and energy projects. Timing is also a factor with the ability to be "in the front of the line" with programs and projects when oil prices and state expenditures are high. The concept of an All-Alaska Rate stems from the concept of allowing all Alaskans to share more equitably in the benefits of proximity, timing and subsidies. The mechanism is to charge an All-Alaska Rate to all rate payers.

We tested this concept of an All-Alaska Rate at two different price levels or postage stamp rates, $0.14 and $0.20. These rates are the current electric kWh rates in Anchorage ($0.14) and approximately the statewide average ($0.20) rate which is also the average statewide effective PCE rate (Fay, Villalobos, Gerd 2010; Fay and Villalobos 2011).

Because no long-term price elasticity of demand measure is available at the customer level, we base the analysis on empirical evidence from PCE communities that currently pay lower prices. We applied the new All-Alaska Rates only to those communities paying higher rates than the new lower rate; if a

[4] The North Slope Borough communities benefit from availability of natural gas in some of its communities and additional subsidies. Rate structure is a flat rate of about 15 cents per kWh for all communities in the borough.
[5] Effective rate is the rate that the residential customer actually pays for the first 500 kWh consumed, (Residential Rate – PCE credit).

community was paying a rate lower than the new All-Alaska Rate, their rate would remain unchanged. Below are the assumptions used in the analysis:

- Only rates above the postage stamp rate change.
- Residential rates reflect all costs of producing electricity in a community.
- Consumptions effects are evaluated in the long run based on an empirical review of consumption in North Slope Borough (NSB) communities, which on average have approximately 31% lower rates and consume approximately 66% more electricity than PCE communities.
- The postage stamp rate is available only for the first 500 kWh; any consumption above the cap has a price equal to the current residential rate.
- Changes in prices are measure against current effective rates.
- Consumption changes are measured based on their relationship with simple changes in prices. No adjustments to consumption are made give the price discontinuity.[6]

Table S3 shows the results of the $0.14 and $0.20 rate scenarios. The table shows the current conditions before applying the All-Alaska Rate including kWh consumption, revenues, population affected and the current cost to the State of providing economic disbursements in CY 2010.

If only ratepayers paying higher rates are affected, an All-Alaska Rate set at $0.14 means that PCE utilities would have their rates change (-37% on average) and non-PCE utilities would have their rates change (-25% on average). In PCE communities, approximately 25,500 customers are affected by the rate change while in non-PCE communities, approximately 72,000 customers are affected. The rate change is estimated to result in a 55% increase in kWh consumption in PCE communities and a 14% increase in kWh consumption in non-PCE communities (Table S3).

As the rates and consumption change, utility revenues also change; PCE utilities collect 68% more revenue while non-PCE communities collect 12% more revenue. However, costs also increase about 62% for PCE utilities and 12% for non-PCE communities. This requires additional payments to utilities to make up the difference--$15.1 million to PCE utilities and $21 million to non-PCE utilities. The total disbursements for all affected utilities would be $62.5 million or a $36.5 million (57%) increase in costs of the program (Table S3).

If the All-Alaska Rate is set at $0.20, 65 PCE communities have lower effective rates and 12 non-PCE utilities have lower rates. If only ratepayers paying higher rates are affected, under an All-Alaska Rate set at $0.20 the PCE utilities would have their rates change (-26% on average) and non-PCE utilities would have their rates change (-5% on average). In PCE communities, approximately 12,000 customers are affected by the rate change while in non-PCE communities, approximately 40,500 customers are affected. The rate change is estimated to result in a 26% increase in kWh consumption in PCE communities and a 5% change in kWh consumption in non-PCE communities (Table S3).

As rates and consumption change, utility revenues also change; PCE utilities collect 17% more revenue while non-PCE communities see no change in revenue. Total costs also increase about 20% for PCE

[6] This results in an overestimation of consumption.

utilities and about 1% in non-PCE communities. This requires additional payments to PCE utilities--$6.1 million-- to make up the difference and about $0.8 million in additional payments to non-PCE utilities. The total disbursements for all affected utilities would be $33.3 million meaning no effective change compared to current PCE program costs.

Table S3. All-Alaska rate program long run scenario at $0.14 and $0.20 per kWh

	PCE	Non PCE	PCE	Non PCE
Total # of communities/utilities	169	14	169	14
Population	75,985	408,342	75,985	408,342
Total kWh before All-Alaska rate	117,897,443	1,966,507,000	117,897,443	1,966,507,000
Base total cost	$51,500,000	$284,800,000	$51,500,000	$284,800,000
Base total revenue	$25,200,000	$284,800,000	$25,200,000	$284,800,000
Base total disbursements	$26,300,000		$26,300,000	
All- Alaska rate @	***$0.14***	***$0.14***	**$0.20**	**$0.20**
# utilities/communities with lower effective rate	8	9	65	12
% utilities/communities with lower effective rate	5%	64%	38%	86%
			if only higher rates change	
Total kWh after All-Alaska rate	182,354,824	2,247,777,120	135,742,511	1,976,231,386
Average % consumption change	55%	14%	15%	0%
			in affected communities	
Average % change in rate	-37%	-25%	-26%	-5%
Total number customers affected	25,521	72,426	12,370	40,475
Total cost after	83,700,000	339,300,000	61,800,000	286,800,000
Total revenue after	$42,200,000	$318,200,000	$29,400,000	$286,000,000
Total disbursements after	$41,500,000	$21,000,000	$32,400,000	$800,000
Additional disbursements	$15,100,000	$21,000,000	$6,100,000	$800,000
Change in disbursements	57%		23%	
Total disbursements to all communities	$62,500,000		$33,300,000	

Another potential scenario is the implementation of a regional rate. For example, in Southeast Alaska there are a number of communities with hydroelectric facilities paying rates substantially less than communities using diesel to generated electricity. An incremental increase of about 2 cents in rates paid in communities that benefited from partially publically funded hydroelectric projects could equalize the rates paid in all the other communities with diesel generation to $0.10 (Table S4). This is also substantially less costly than building additional hydroelectric facilities and transmission lines,[7] would remove all Southeast communities from the PCE program, and more equitably distribute public subsidies in the region.

[7] Black and Veatch, 2011, *Southeast Alaska Integrated Resource Plan*, prepared for the Alaska Energy Authority. http://www.akenergyauthority.org/SEIRP/12-23-2011_Vol1_SoutheastAlaskaIRP.pdf

Table S4. Southeast Alaska regional scenario

PCE Communities Southeast Region	CY2010	CY2009
Total # of communities	20	20
Total kWh before All AK rate	23,339,991	25,329,416
Base total cost	$7,400,000	$7,600,000
Base total revenue	$4,100,000	$4,500,000
Base total disbursements	$3,300,000	$3,100,000
Total kWh after regional rate	42,496,095	46,128,855
Average % consumption change	82%	82%
Average % change in rate	-46%	-46%
Total number of customers affected	5,340	5,211
Total cost after	$13,900,000	$14,400,000
Total revenue after	$4,200,000	$7,800,000
Total disbursements after	$6,700,000	$6,600,000
Additional Disbursements	$3,400,000	$3,500,000
Change in disbursements	104%	113%
Funds required	$6,700,000	$6,600,000
kWh sold to Non PCE SE communities	283,229,000	289,057,000
Rate increase/kWh to Non-PCE SE communities	**$0.024**	**$0.023**

Infrastructure costs

What are not included in this analysis are potential costs of infrastructure that would be required to meet the growth in demand in PCE communities under the new All-Alaska Rates. In order to calculate these potential costs, more information is needed on the current generation and distribution capacity in each community and the extent to which this infrastructure could accommodate growth in demand, which in both scenarios is substantial. While demand growth in PCE communities is estimated to increase substantially, energy efficiency end use measures could potentially be used to meet approximately half of the increase based on energy efficiency studies completed by the Alaska Energy Authority.[8]

It is important to evaluate an "everyone pays" the rate option where people who currently enjoy lower rates help pay the cost of the new more equitable rates. In many cases, electric customers paying rates lower than $0.14 per kWh are doing so because of construction subsidies for hydroelectric projects and sale of the projects for less than their full costs to utilities. Under a $0.14 rate, these rate payers would still be paying lower rates than the true costs of the power they are consuming. The "everyone pays" scenario also results in ratepayers helping to shoulder a larger share of the costs of power production. A

[8] Butler, G. (2010). *Nightmute Final Report Lighting & Weatherization Measures 2008 – 2009*, Alaska Building Science Network, prepared for the Alaska Energy Authority.

potential result of this approach is greater citizen engagement in state energy policy and financing as well as improved allocation of energy resources.[9] However, to appropriately evaluate a scenario in which all customer rates are allowed to change, a long-run price elasticity of demand is required. As additional and more disaggregated data becomes available at the customer level, it may allow a more accurate estimation and evaluation of potential scenarios in which a postage stamp rate could be implemented.

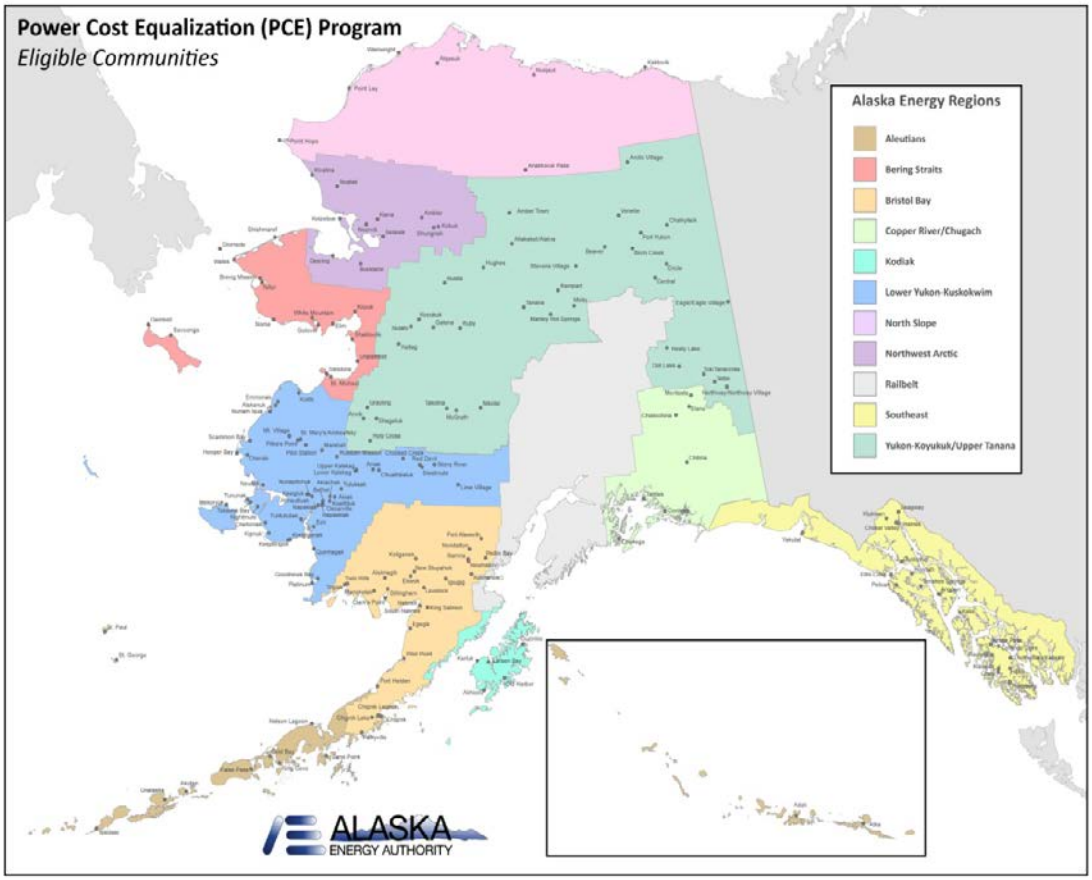
[9] See Black and Veatch, 2011, Southeast Alaska Integrated Resource Plan, Executive Summary, 1-4, Space Heating discussion. http://www.akenergyauthority.org/SEIRP/12-23-2011_Vol1_SoutheastAlaskaIRP.pdf

Introduction

Economists at the Institute of Social and Economic Research, University of Alaska Anchorage were asked to research the potential options and impacts of establishing an All-Alaska Rate as an alternative to the current Power Cost Equalization (PCE) program funding formula. We were asked to provide a history of the PCE program and information on electricity rates and patterns of consumption across regions of Alaska. This report provides the results of this analysis.

Alaska is unique in many ways including its consumption and pricing of electricity. There are also large regional differences in consumption and prices that result from proximity to different types and quantities of resources. Differences in remoteness and population size also influence costs. Urban areas in the southern Railbelt benefit from larger economies of scale and access to natural gas and hydroelectric resources; the majority of hydroelectric facilities are located in Southcentral and Southeast Alaska. Most communities in rural Alaska depend on volatile and high price fossil fuels for the generation of electricity. These differences result in significant differences in energy consumption and prices. The Alaska Energy Authority (AEA) uses eleven energy regions to help identify large geographic areas with similar characteristics. These AEA energy regions are used in this review (Figure 1).

Figure 1. Alaska Energy Regions Map and PCE Eligible Communities



Source: Alaska Energy Authority

Review of Current Residential Consumption and Price of Electricity

In CY 2009, U.S. residential customers consumed an average of 10,896 kWh per year or 908 kWh per month; the average residential rate was 9.8 cents/kWh. There is no region in Alaska with that level of electricity consumption. Even the region with the highest annual residential consumption (North Slope) consumes almost 25% less (8,230 kWh). The state with the lowest average residential consumption in 2009 was Maine (6,252 kWh). Only two Alaska regions have higher average consumption levels, North Slope (8,230 kWh) and Railbelt (7,514).

Average annual per customer residential consumption in most Alaska regions is between 4,000 and 6,000 kWh per year or 333 and 500 kWh per month. The Yukon-Koyukuk/Upper Tanana region has the lowest at just over 3,000 kWh per year or 250 kWh per month. Within geographic regions there is also considerable variation. For example, in the Railbelt average annual consumption in Fairbanks is 8,285 kWh and Anchorage is 7,475 kWh. Table 1 lists the average annual residential consumption per customer for years 2008 to 2010 and residential electric rates per kWh.

Table 1. Average Annual Residential Electricity Consumption and Rates, 2008-2010

	kWh per Customer			Before PCE			After PCE		
AEA Region	2008	2009	2010	2008	2009	2010	2008	2009	2010
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Kodiak	4,380	4,779	5,145	0.20	0.17	0.18	0.12	0.13	0.16
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North Slope	5,918	7,480	8,230	0.14	0.14	0.13	0.11	0.13	0.12
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Yukon-Koyukuk/ Upper Tanana	3,191	3,348	3,322	0.53	0.52	0.52	0.20	0.22	0.23

Source: Alaska Energy Statistics 1960-2010, (2011).

The Alaska statewide weighted average residential rate for electricity (16 cents per kWh in CY2009) is significantly higher in than the U.S. average of 9.8 cents per kWh. Hidden in the statewide average is considerable variation with some communities paying less than the national average and some paying considerably more (even with the Power Cost Equalization program effective rate). Similar to consumption, differences between and within regions are very large. Table 1 shows that the Railbelt and Southeast regions have the lowest average residential rates. North Slope residential customers also have lower average rates because some communities in the North Slope region have access to more affordable natural gas and the North Slope Borough provides energy payments in addition to PCE

disbursements. Most other regions have rates two to three times those of urban Alaska areas. Some communities with hydroelectric power have the lowest rates but in most cases customers are not paying the full, true cost of power because the cost of construction was heavily subsidized by state and federal governments.

Below we review specific characteristics of resources, consumption and rates in all AEA regions. The figures provided in these summaries are based on CY 2010 PCE program data. Appendix G provides detailed information by community.

Aleutians

The Aleutians Region includes eleven communities. Most communities in this region generate electricity with fuel oil; about 5% of power generation in the region is from hydroelectric resources. Average annual consumption per customer for communities in this region is between 5,000-6,000 kWh. Communities such as Adak, Nikolski, Nelson Lagoon and False Pass have some of the lowest consumption (about 3,500 kWh) in the region while communities such as Dutch Harbor, Cold Bay, Saint Paul and King Cove have the highest consumption, almost twice as much as communities with the lowest levels. These communities benefit from larger economies of scale not only because they have significantly more residential customers but they also have more, large commercial and/or industrial customers. Without PCE, the communities in this region would pay almost four times more for electricity than the urban customers in the Railbelt. However, with PCE, average rates in the Aleutians region range from about 14-36 cents per kWh.

Bering Straits

The Bering Straits region includes sixteen communities. Most communities in this region generate electricity with fuel oil; about 5% of power generation in the region is from wind resources. Average consumption per customer for communities in this region is between 4,000-6,000 kWh per year. Communities such as Diomede, White Mountain, Teller and Nome have the lowest levels of consumption ranging from about 3,000-3,500 kWh per year. Koyuk, Saint Michael and Shaktoolik have the highest levels of consumption (almost 6,000 kwh). Residential rates range from 36 cents/kWh (Nome) to 72 cents/kWh (White Mountain) before PCE. However, average rates after PCE adjustment range from 14 to 44 cents/kWh with most communities (13 of 16) paying between 33%-66% more than urban customers in the Railbelt.

Bristol Bay

The Bristol Bay region includes twenty-two communities. Almost all electricity in Bristol Bay is generated using fuel oil. Communities in the Bristol Bay region have an average consumption per customer ranging between about 3,000 to less than 6,000 kWh per year. Communities such as Levelock, Pilot Point, Egegik and Koliganek have the lowest levels of consumption, just over 3,000 kWh per year. Chignik Lagoon, New Stuyahok and Dillingham have the highest levels of consumption of over 5,000 kWh per year. Residential rates before PCE range between 43 to 92 cents/kWh (about three to six times higher than urban customers). Average rates after PCE adjustment range from about 15 to 50 cents/kWh. The highest rates after PCE adjustment are paid by Perryville and Pedro Bay customers, which pay over three times more than urban customers.

Cooper River/Chugach

The Cooper River/Chugach region includes seven communities. Over half (55%) of all electric generation in this region is done using hydroelectric resources while the rest (45%) is generated using fuel oil. Communities in the Cooper River/Chugach region have an average consumption per customer ranging from about 3,300 to 6,200 kWh per year. Valdez and Cordova have the highest consumption and benefit from hydroelectric power generation. Chitina and Slana have the lowest consumption levels. Residential rates before PCE range from 22 to 66 cents/kWh. After PCE, average rates range from 16 to 41 cents/kWh; Tatitlek pays the highest rate.

Kodiak

The Kodiak region includes five communities. Most of the electricity generation in Kodiak is done using renewable resources, about 84% from hydroelectric and about 9% from wind facilities; only 8% of electricity is generated using fuel oil. Communities in the Kodiak region have an average consumption per customer ranging from almost 4,000 to over 7,000 kWh per year. Kodiak and Karluk have the highest levels of consumption. Kodiak has large hydroelectric resources and the largest wind generation installed capacity in Alaska, producing almost all of its power with renewable resources. Old Harbor and Ouzinkie have the lowest consumption levels. Residential rates before PCE range from 18 to 60 cents/kWh. After PCE, average rates range from 18 to 26 cents per kWh; Karluk and Larsen Bay pay the highest rates.

Lower Yukon-Kuskokwim

The Lower Yukon-Kuskokwim region includes 45 communities. Most of the electricity generation in this region is done using fuel oil (98%), although recently a small amount, about 2%, is from wind resources. The Lower Yukon-Kuskokwim region has a wide range of average annual consumption per customer from about 1,000 to just over 6,000 kWh. Lime Village, Stony River and Newtok have the lowest levels of consumption (less 2,000 kWh) while Bethel and Napaskiak have the highest levels of consumption (over 6,000 kWh). Average residential rates before PCE range from 42 cents per kWh to $1.17 per kWh. After PCE, residential rates range from about 13 cents per kWh to 75 cents per kWh. Lime Village pays the highest rate, and Newtok a distant second pays about 39 cents per kWh. About seven communities[10] in this region have wind turbines producing a portion of their electricity.

North Slope

The North Slope region includes eight communities. A unique characteristic of this region as compared to other rural Alaska regions is that almost two thirds of their electricity generation uses natural gas and only 34% is produced from fuel oil. Natural gas is used in electric generation in the communities of Barrow and Nuiqsut. Also, unlike other regions in rural Alaska, residential customers in the North Slope regions consume electricity at the same levels as urban customers. Average consumption in this region ranges from about 7,500 kWh to almost 10,000 kWh. Anaktuvuk Pass and Kaktovik have the lowest levels of consumption while Atqasuk and Point Hope have the highest. Residential rates before PCE

[10] The seven communities are: Chevak, Hooper Bay, Kasigluk, Mekoryuk, Quinhagak, Toksook Bay and Kongiganak; for details on wind generation in 2010 please see *Alaska Energy Statistics 1960-2010* http://www.iser.uaa.alaska.edu/Publications/AlaskaEnergyStatisticsCY2010Tables.xlsx

range from 12 to 17 cents. Some communities receive small PCE adjustments and in some cases consumers may enjoy even lower rates than urban consumers because the electricity rates are also subsidized by the borough.

Northwest Arctic

The Northwest Arctic region includes ten communities. Most electricity generation in this region uses fuel oil (91%), followed by a small amount of renewable resources, about 7% from hydroelectric and 2% from wind. The Northwest Arctic region consumes electricity closer to the levels of urban consumers. Average residential consumption per customer ranges from almost 5,000 kWh to almost 8,000 kWh. Ambler, Kobuk and Kiana have the lowest levels of consumption while Shungnak, Noatak and Kotzebue have the highest levels. Residential rates before PCE are high, ranging from 47 to 87 cents per kWh. However, after PCE rates range from 17 to 30 cents per kWh; Buckland and Kobuk have the highest rates.

Railbelt

The Railbelt includes five urban communities: Anchorage, Palmer-Wasilla, Fairbanks, Homer and Seward and are not eligible for the PCE adjustment. There are six interconnected utilities that serve this region.[11] These utilities not only serve the main urban centers but also a number of communities along the Railbelt that are connected to the grid (Appendix C). Most of the electricity generated in the Railbelt is from natural gas (72%), followed by fuel oil (11%), hydroelectric (10%) and coal (8%).[12] Average residential consumption per customer ranges from over 7,000 to almost 8,500 kWh per year. Homer has the lowest consumption levels while Palmer (Mat-Su area) has the highest consumption levels. Average residential rates range from 14 cents/kWh in Anchorage to 20 cents/kWh in Fairbanks.

Southeast

The Southeast region includes twenty-six communities and consumption varies significantly across communities. Some communities have abundant hydroelectric resources while other communities may be significantly smaller and only have diesel generation systems. In total about 97% of all electric generation in Southeast is produced by hydroelectric facilities while only 3% is produced with fuel oil. Average residential consumption per customer ranges from almost 2,000 to just over 15,000 kWh per year. A portion of the consumption in communities with the highest consumption is due to the use electric heating. Communities with the highest levels of consumption (above 10,000 kWh/year) include Ketchikan, Metlakatla, Wrangell, Sitka and Petersburg; none of these communities are eligible to receive PCE.

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[11] These utilities are: Chugach Electric Association (CEA), Anchorage Municipal Light & Power (AML&P), Golden Valley Electric Association (GVEA), Homer Electric Association (HEA), Matanuska Electric Association (MEA), and Seward Electric Association (SEA). In addition, Copper Valley Electric Association (CVEA) serves two small communities in the Railbelt region, Lake Louise and Nelchina. CEA is the main utility provider for the Cooper River/Chugach area as defined by the AEA Energy Regions.

[12] Generation by fuel type figures are estimates for CY 2010 from the *Alaska Energy Statistics 1960-2010* by Fay, Ginny, Alejandra Villalobos Meléndez and Amber Converse, September 2011 available at http://www.iser.uaa.alaska.edu/Publications/AlaskaEnergyStatisticsCY2010Report.pdf

However, most other communities (20) in the region are eligible for and receive PCE because their electricity generation is primarily with fuel oil and rates are up to two or three times as much as the hydroelectric communities. For example, even after the PCE adjustment communities such as Angoon, Hoonah, Whale Pass pay about 20 cents/kWh; Tenakee Springs paid the highest average rate in the region of about 30 cents per kWh. The average residential rate for the high consumption communities is between 9 and 11 cents per kWh; again these are highly subsidized hydroelectric rates and not the true cost of power from these facilities. Communities with the lowest levels of consumption (below 2,000 kWh per year) include Gustavus, Elfin Cove and Tenakee Springs, which also have relatively high levels of seasonal tourism and second homes. Average residential rates range between 21 and 64 cents per kWh before PCE. After PCE, average residential rates range from 15 to 32 cents per kWh; Tenakee Springs and Gustavus have the highest rates.

Yukon-Koyukuk/Upper Tanana

The Yukon-Koyukuk/Upper Tanana region includes thirty communities. Average residential consumption per customer ranges from about 1,500 to almost 5,500 kWh per year. Tok and Huslia have the highest consumption levels in the region, while Chakyitsik and Manley Hot Springs have the lowest levels of consumption. Before PCE, residential rates range from 39 cents per kWh to $1.02 per kWh. After PCE, residential rates range from 14 to 54 cents per kWh. Chalkyitsik and Takotna have the highest rates.

Power Cost Equalization History

The first electricity assistance program established by the Alaska State Legislature was called the Power Production Cost Assistance (PPCA) program. It was implemented during state Fiscal Year (FY) 1981. Through this program, a portion of the generation and transmission costs of utilities with high rates were paid, which enabled utilities to reduce rates for residential, community facilities and charitable organization customers. About 15 utilities participated in this program benefiting 11,405 residential and commercial customers, 238 organizations and 473 community facilities (Alaska PowerAuthority, 1988). The PPCA program covered about 33% (40,490 megawatt-hours) of generated power. At that time the average per gallon cost of fuel for participating utilities was $1.054 (about $2.64 in 2010$$).[13] However, the program lasted only one fiscal year during which it distributed $2.2 million in assistance (about $5.5 million 2010$$).

The Legislature instituted significant modifications to the program in FY 1982 and renamed it the Power Cost Assistance (PCA) program. This program operated from FY1982 to FY1984. The major changes included increases in the entry and ceiling rates, decrease in the portion of eligible costs for reimbursement and the inclusion of distribution and administration as eligible cost categories. The last year the program was implemented, it served 61 utilities benefiting 21,702 residential and commercial customers and 985 community facilities (Alaska PowerAuthority, 1988). The PCA program reduced the price of about 40% (96,520 megawatt-hours) of the generated power. At that time, the average per

[13] PCE program data is calculated on a fiscal year basis. The fiscal year starts July 1 and ends June 30. Estimation of figures in constant dollars is done using the average Anchorage consumer price index (CPI) for a fiscal year.

gallon cost of fuel for participating utilities was $1.70 (about $3.62 in 2010$$). The last fiscal year of operation, the PCA program distributed $8.3 million in assistance (about $18.4 million in 2010$$).

The Power Cost Equalization program was created in 1984 when the Legislature enacted Alaska Statutes 44.83.162-165 replacing the Power Cost Assistance program. The program became effective in October 1984 (FY 1985) and was funded through appropriations from the general fund of about $6.67 million (2010$$). The PCE program has had only a few modifications over its almost 26 year life. Table 2 describes the differences across the programs, which in their basic structure and funding formulas are quite similar.

Table 2. Timing and characteristics of implemented power cost assistance programs

	PPCA (FY 1981)	PCA (FY 1982-1985)	PCE (FY 1985)	PCE (FY2000)	PCE (FY 2011)
Base rate (2010 cents/kWh)	18.4	24.3	17.2	15.2	14.0
Ceiling rate (2010 cents/kWh)	96.0	91.2	106.4	66.5	100.0
Eligible costs for reimbursement	85%	95%	95%	95%	95%
Eligible costs for reimbursement over ceiling	Yes, 100%	No	No	No	No
Consumption Limits – Community Facilities[b] kWh/month	None	55 kWh per Resident	70 kWh per Resident	70 kWh per Resident	70 kWh per Resident
Residential & Commercial Consumption Limits kWh/month –	N/A	600	750[c]	500 Commercial no longer eligible	500 Commercial no longer eligible
Eligible cost categories for reimbursement	only generation and transmission	generation, transmission, distribution and administrative			

Source: Modified table "Comparison of PPCA, PCA, PCE and PCE-REC" (Brooks, 1995)

[b] Community facilities is defined as water and sewer facilities, charitable educational facilities, public lighting, or community buildings whose operations are not paid by the state, federal government or private commercial party.

[c] Starting in 1993, the PCE eligible kWh per month limit dropped to 700.

Program Implementation

The responsibilities of administering the PCE program are divided between the Regulatory Commission of Alaska (RCA)[14] that evaluates utility eligibility and costs per kilowatt-hour (PCE level), and the Alaska Energy Authority (AEA)[15] that determines the number of eligible kilowatt-hours in order to calculate the appropriate payment and make the disbursement. The Legislature established criterion for utility eligibility that excluded urban areas and regions that benefited from state funded hydroelectric development (Four Dam Pool utilities-- Kodiak, Port Lions, Valdez, Petersburg, Wrangell and Ketchikan) (Matz & Kreinheder, 1988, p. 11).

Seven years after the PCE program was established, funding the program became a challenge as world oil prices decreased sharply lowering State revenues. Since inception, the program was not fully funded by the Legislature in 15 out of 25 fiscal years. In 1990, in an attempt to contain costs, the Legislature directed the Alaska Public Utilities Commission to implement new efficiency and line loss standards and to more clearly define eligible costs. To further address high operating costs, AEA provided technical support, preventive maintenance and upgrading/replacing equipment of rural utilities (Pourchot, 1990, p. 11).

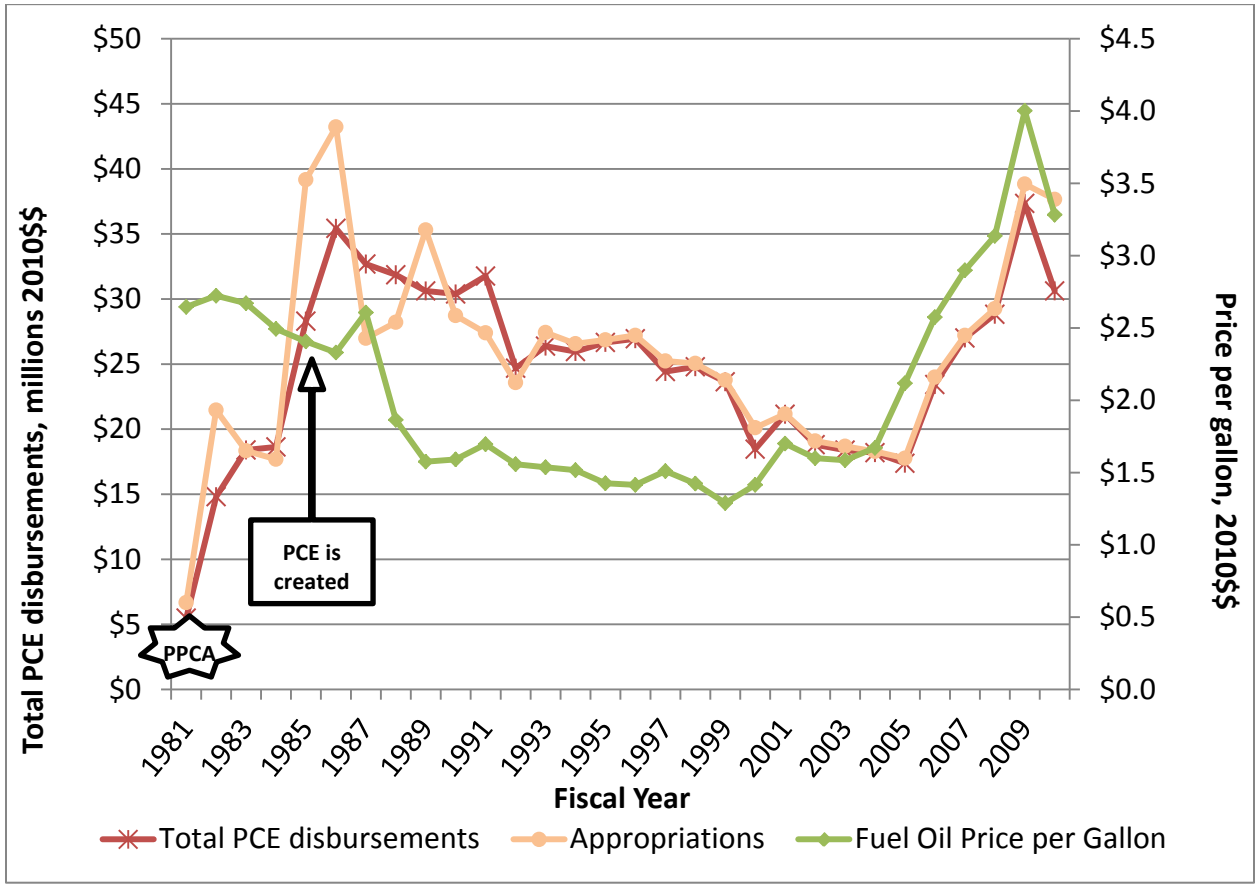
In FY 1992, the program was pro-rated to 80% eligible PCE payments because of funding shortfalls for eleven months of the year. One year later, the Power Cost Equalization and Rural Electric Capitalization Fund (the PCE fund) was created by the Legislature with an appropriation of $101 million (2010$$). During subsequent years, PCE expenses were drawn exclusively from the PCE fund and were nearly spent by the end of FY 1999 (State of Alaska, Office of the Governor, 1999). This continued to be an issue for the next sixteen years with the exception of FY 2000 when the PCE program had full funding for one year.[16] Then, during FY 2001, the PCE Endowment fund was created. Originally the fund was capitalized using the proceeds from the sale of the Four Dam Pool Projects and funds from the Constitutional Budget Reserve. Later in 2007, the fund was once again capitalized with general funds. The Rural Electric Capitalization Fund and PCE program costs are appropriated using dividends from the PCE fund[17] (Alaska Energy Authority, 2009, p. 2). For the last three fiscal years, the PCE program again received full funding. Last year the legislature appropriated an additional $400 million for the PCE endowment fund. Figure 2 shows annual PCE appropriations, disbursements and average distillate fuel oil prices since the program was implemented.

Total electricity (kWh) sales of participating utilities steadily increased until FY 1999, the last year commercial customers where eligible to receive the PCE credit (Figure 3). Some of this increase resulted from additional utilities participating in the program. In FY 1999, in addition to eliminating reimbursements to commercial customers, the number of eligible kWh per month per residential customer was decreased from 700 to 500. After that adjustment, total consumption re-adjusted

[14] Originally APUC, Alaska Public Utilities Commission.
[15] Originally APA, Alaska Power Authority
[16] Appendix A details PCE funding levels per year
[17] The fund is managed by the Department of Revenue; it is invested to earn 7% over time. Seven percent of the fund's 3-year monthly average returns may be appropriated.

downward, and continued an upward trend. However, the total number of kilowatt-hours eligible for reimbursement has remained relatively flat over time following adjustments in eligibility levels in FY 1993[18] and FY 2000. During the years of the PCE predecessor programs both sales and eligible kilowatt-hours exhibited higher growth, largely due to the increase in the number of participating utilities.

Figure 2. PCE appropriations, disbursements and distillate fuel oil prices per gallon in the electric sector over time



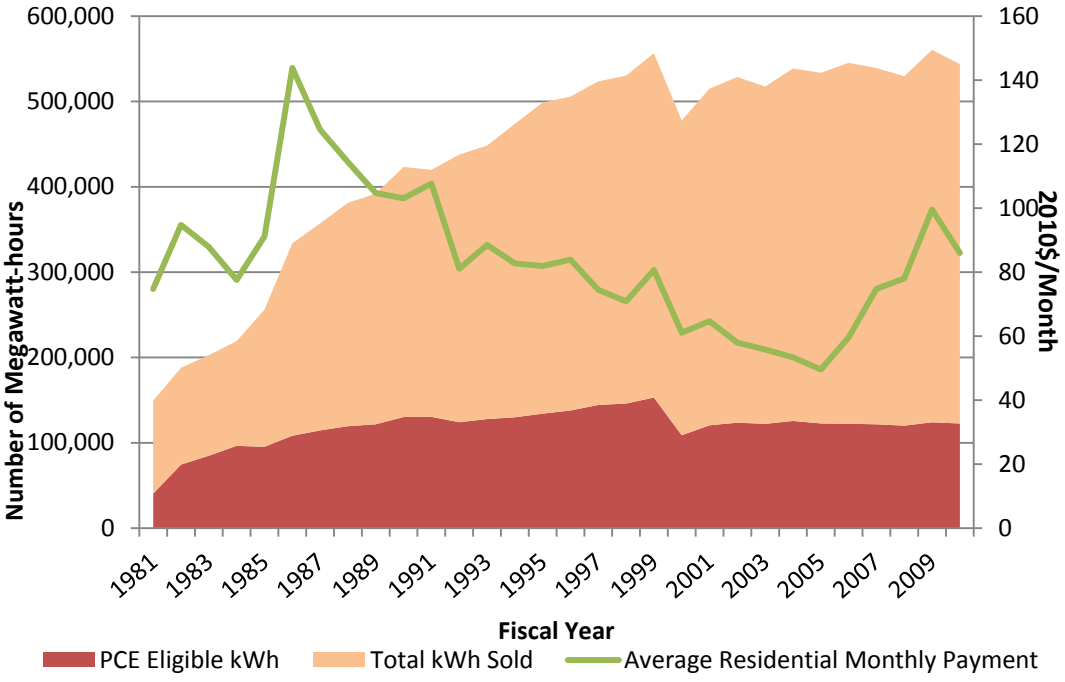
Source: PCE Statistical Reports 1988-2010 and authors' calculations.

The average number of eligible kilowatt-hours grew at about 5% per year since FY 1985; the average annual population growth in participating utilities was 2% over the same time period. Figure 3 shows kilowatt-hours sold, PCE eligible kWh and the average residential monthly payment per customer since disbursements became available to residential customers. The sharp declining trend during the 1990s and first half of 2000s results from pro-rated PCE disbursements due to lack of funding (Appendix A). Figure 4 shows kWh sold and PCE eligible kWh with average kWh sold per capita; notably per capita electricity consumption continued to steadily rise in the years of pro-rated funding. The sharp increase starting in FY 1985 coincides with the increase in eligible kWh from 600 (under the PCA program) to 750 after the PCE program was instituted and the increase in participating utilities. The sharp decrease in per

[18] In 1993, residential customer eligible kWh dropped from 750 to 700.

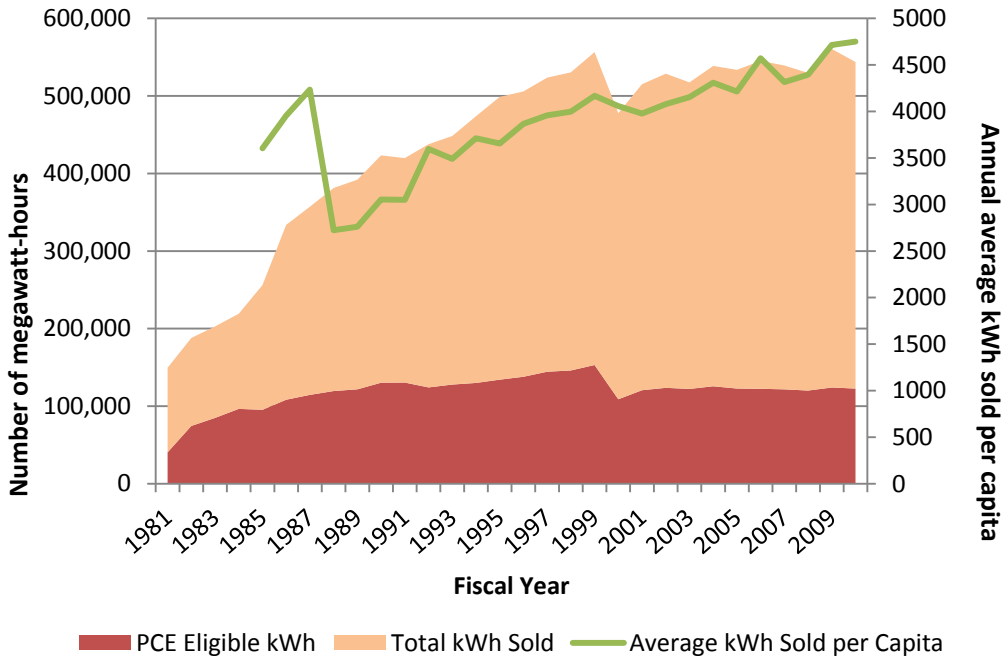
capita consumption between FY 1987 and FY 1988 coincides with the crash of the Alaska economy due to low in world oil prices.

Figure 3. Power sold, PCE eligible kWh and average residential monthly payment, 1981 to 2010



Source: Statistical Reports of the Power Cost Equalization Program 1988-2010

Figure 4. Power sold, PCE eligible kWh and average annual kWh sold per capita, 1981 to 2010



Source: Statistical Reports of the Power Cost Equalization Program 1988-2010

Table 3 shows eligibility and participation by utilities across regions of Alaska; in 2010, 182 utilities were eligible and participated.

Table 3. Utilities/Communities Eligible and Participating in PCE Program, CY 2010

AEA Energy Region	Yes	Inactive	No	Total	Percent Active
Aleutians	12	1	0	13	92%
Bering Straits	17	0	0	17	100%
Bristol Bay	25	1	0	26	96%
Copper River/Chugach	6	0	2	8	75%
Kodiak	4	1	1	6	67%
Lower Yukon-Kuskokwim	48	0	0	48	100%
North Slope	7	1	0	8	88%
Northwest Arctic	12	1	0	13	92%
Railbelt	0	0	14	14	0%
Southeast	21	0	10	31	68%
Yukon-Koyukuk/Upper Tanana	38	3	2	43	88%
Total	**190**	**8**	**29**	**227**	**84%**

Note: For utilities that serve multiple communities with no grid such as AVEC and AP&T, each community is counted individually. Source: Alaska Energy Statistics report 1960-2010, ISER (2011).

Electricity Rates and Levels of Consumption

The biggest challenge in providing electricity (and other public services) to rural residents lies in the lack of economies of scale; this intractable problem is difficult to overcome. The fixed costs associated with running a utility are large and if the number of customers and/or levels of consumption are very small these costs must be spread out over very few customers and kilowatt-hours. Most PCE communities are similar in that they produce all or most of their electricity using diesel generators, have small populations, and customers pay electricity rates higher than customers in Anchorage, Fairbanks and Juneau. However, across PCE communities there are significant differences in remoteness, population sizes (ranging from 8 to about 6,000 people), available means for transporting and storing fuel, income and other factors that ultimately affect their electricity prices.[19] Hence, there is a large variability in electricity rates across PCE communities, which in turn, affect their levels of electricity consumption (Table 4).

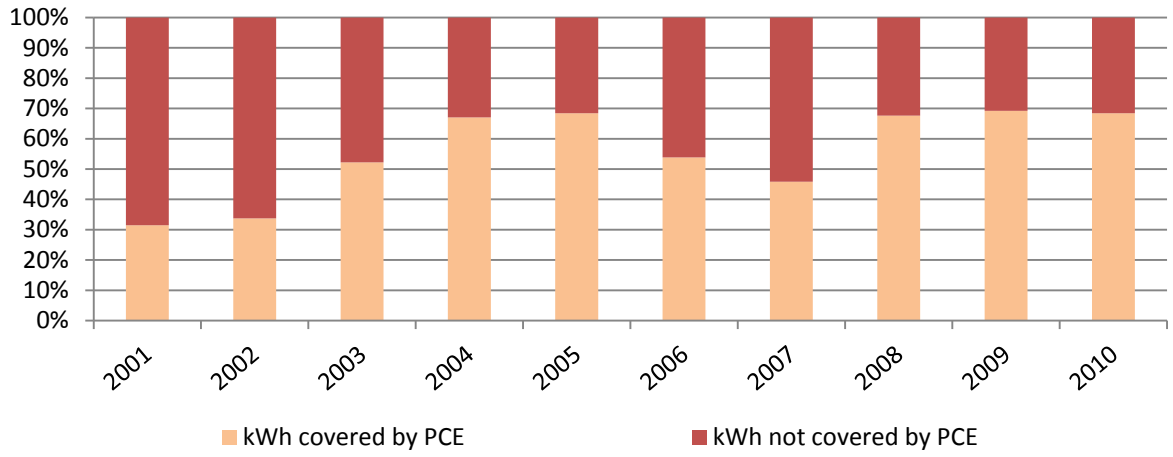
However, on average, PCE residential customers consume significantly less (over 40%) electricity per month than customers in urban areas of Alaska. Average annual per customer residential consumption in most Alaska regions is between 4,000 and 6,000 kWh per year or 333 and 500 kWh per month. The Yukon-Koyukuk/Upper Tanana region has the lowest at just over 3,000 kWh per year or 250 kWh per month. In the Railbelt average annual consumption in Fairbanks is 8,285 kWh and Anchorage is 7,475

[19] Appendix F lists PCE communities and their residential and effective rates, average consumption per residential customer per month, population, average household size (2004), average real median income (2004) and average fuel prices in 2009.

kWh or 690 kWh and 623 kWh per month, respectively. The average PCE utility generates less than 3,000 MWh per year; about 30% of the utilities generate less than 500 MWh and the smallest generate less than 30,000 kWh per year. By comparison, urban utilities (Anchorage and Fairbanks) generate over 1 million MWh per year. This means urban utilities produce over 300 times as much power as the average PCE utility.

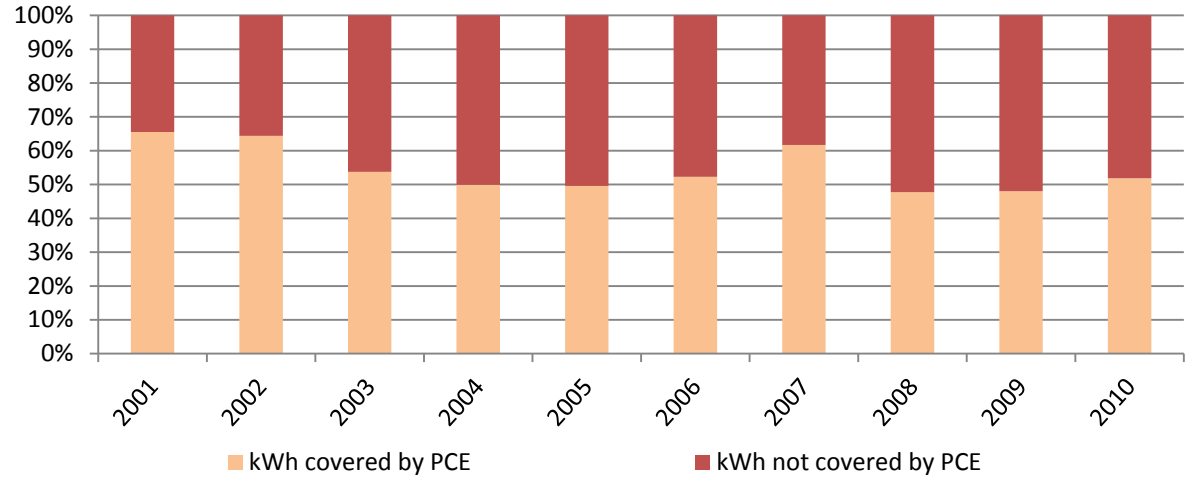
Overall, less than 30% of all kWh sold in PCE communities receive PCE credit. However, the importance of this assistance to residential customers and community facilities is significant. As illustrated in Figure 4, in CY2010, almost 70% of all residential kilowatt-hours received PCE credit. PCE also provides significant assistance to community facilities; Figure 5 shows that of all kilowatt-hours consumed by community facilities in CY2010, about 50% received PCE reimbursement.

Figure 4. Residential kWh sold in PCE communities



Source: PCE Annual Statistical Reports 1988-2010 and authors' calculations.

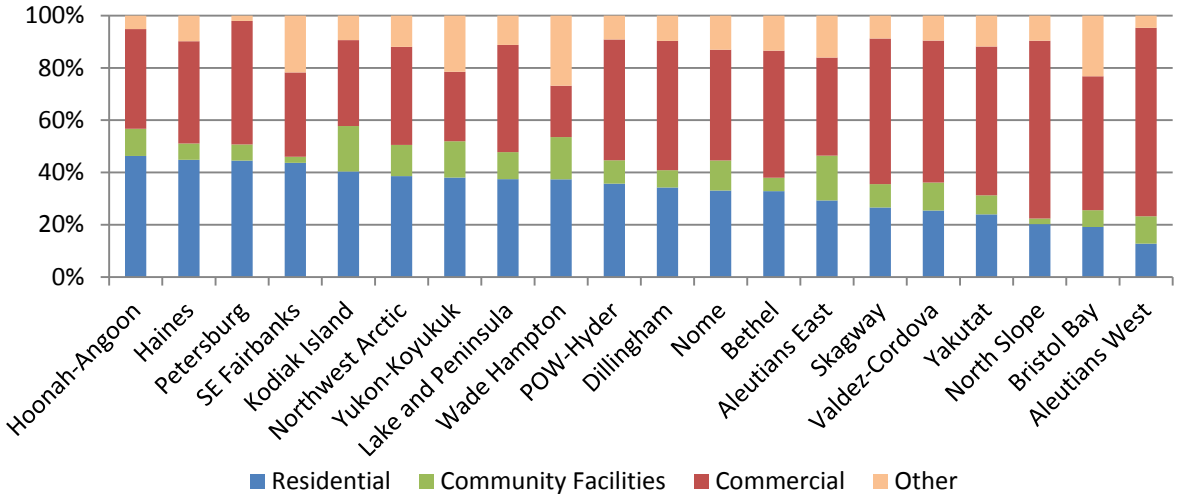
Figure 5. Community Facilities kWh sold in PCE communities



Source: PCE Annual Statistical Reports 1988-2010 and authors' calculations.

The effect of the PCE program varies across communities depending on the proportion residential and community facilities comprise of total utility kWh sales. Figure 6 shows kWh sales by customer category by census area. Regions are organized from the largest to smallest residential customer share to illustrate the regional differences in demand composition by customer categories. It illustrates how in the census areas of Hoonah-Angoon or Yukon-Koyukuk among others, residential and community facilities sales account for about 50% of total kilowatt-hours sold. In comparison, in census areas such as Bristol Bay or North Slope, residential and community facility sales are less than about 25% of total kilowatt-hours sold. Most of the regions on the right side of the chart with large portions of commercial customer power sales have large fish processing operations that have high electricity demands.

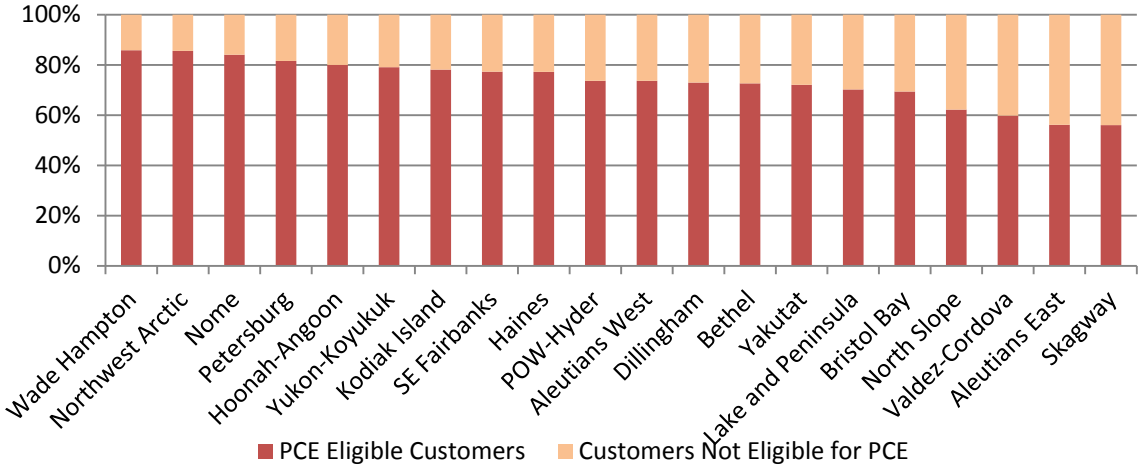
Figure 6. Kilowatt hours sold by customer category and census region, CY 2010



Source: PCE monthly program data CY 2010 and authors' calculations.

Similarly, Figure 7 shows the proportion of eligible customers by region starting with the region with the largest share of eligible customers from left to right. Regions that have large industrial sectors also have lower shares of PCE eligible customers.

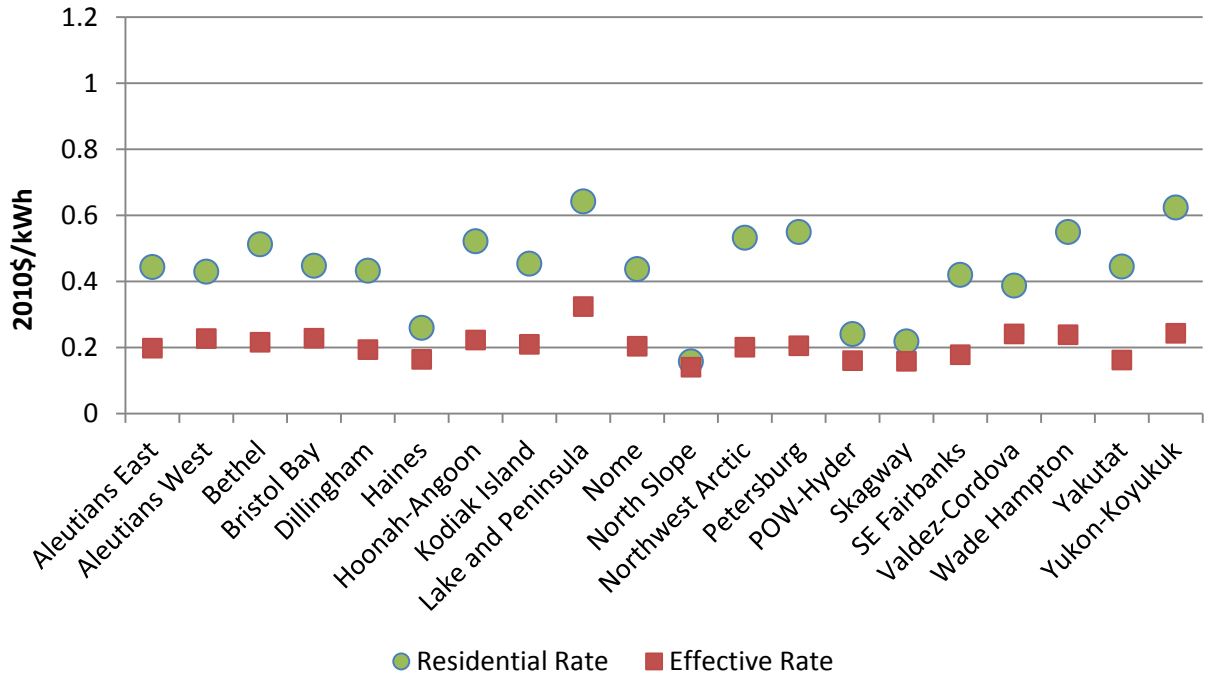
Figure 7. PCE eligible and non-eligible customers by region, CY 2010



Source: PCE monthly program data CY 2010 and authors' calculations.

Figure 8 shows both the average residential and effective rates (residential minus PCE credit). It exemplifies how the PCE program is fairly effective at lowering the effective residential rates for the communities served. Those regions (and communities) with higher rates receive more relief, while regions with lower rates such as the North Slope, receive lower levels of assistance.[11]

Figure 8. Average residential and effective rates of PCE communities by census region, CY2010



Source: PCE monthly program data CY 2010 and authors' calculations. Averages are weighted.

In most PCE communities the average consumption per customer per month is below the 500 kWh PCE eligibility cap. Table 4 shows the different levels of consumption at various rates. During summer months in 2009, less than 18% of eligible communities had average consumption levels above the PCE cap. Most of the communities where average monthly consumption exceeded the 500 kWh cap were communities that have effective rates comparable to those in urban areas (e.g. North Slope[20]), have comparatively high incomes, and/or are located in southeast or southwest Alaska. Even during winter, about 60% of the PCE communities did not have average consumption above 500 kWh per month per customer. On average, as shown in Figure 9, consumers that increase their levels of consumption by more than 10% during the winter months are those in communities where the effective rates[21] are below 30 cents per kWh.

[20] The North Slope Borough communities benefit from availability of natural gas in some of its communities and additional subsidies. Rate structure is a flat rate of about 15 cents per kWh for all communities in the borough.
[21] Effective rate is the rate that the residential customer actually pays for the first 500 kWh consumed, (Residential Rate – PCE credit).

Table 4. Average consumption per customer per month in PCE communities, CY 2009

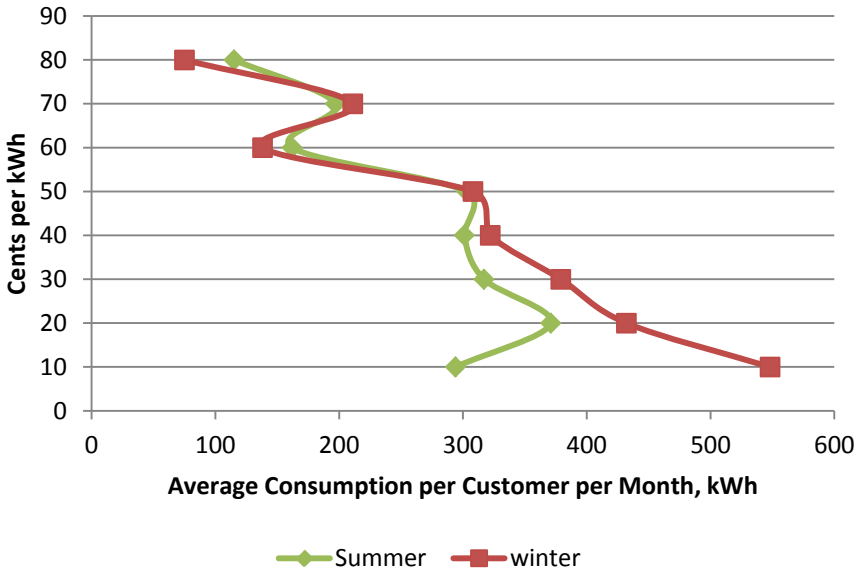
Calendar Year 2009 - Summer (April-September)					
Effective Rate	**Min**	**Mean**	**Max**	**No. Communities**	**No. Observations**
Less than $0.10	203	**294**	345	0	3
$0.10 - $0.19	107	**371**	924	57	527
$0.20 - $0.29	113	**317**	717	96	330
$0.30 - $0.39	140	**301**	486	9	84
$0.40 - $0.49	182	**303**	501	5	27
$0.50 - $0.59	69	**162**	329	2	21
$0.60 - $0.69	115	**197**	293	2	7
More than $0.70		**115**		0	1
Calendar Year 2009 - Winter (October - March)					
Effective Rate	**Min**	**Mean**	**Max**	**No. Communities**	**No. Observations**
Less than $0.10	324	**548**	816	1	6
$0.10 - $0.19	100	**432**	970	49	597
$0.20 - $0.29	92	**379**	966	101	276
$0.30 - $0.39	144	**322**	606	10	58
$0.40 - $0.49	148	**308**	506	7	37
$0.50 - $0.59	53	**138**	365	2	13
$0.60 - $0.69	81	**211**	351	2	8
More than $0.70	59	**75**	91	0	2

Source: PCE monthly program data CY 2010 and authors' calculations. Note that the number of communities in the summer only adds up to 171 and not 172; this is because not all PCE communities file their monthly report year-round. In this case a community only filed during some of the winter months. Also the number of communities within a rate range is determined by taking the monthly average for the season; hence in some cases it may show a number of observations, but zero communities.

Overall price elasticity of demand for electricity in PCE communities is highly inelastic (Villalobos Melendez, 2012) and communities with higher effective rates have significantly lower demand. In addition, generally the consumption range in communities with higher effective rates is measurably smaller than in communities with higher rates. Essentially, residential customers with effective electric rates above $0.30 per kWh are consuming such a small amount of electricity that it is difficult to consume much less during any time of the year.

Measuring how much more households are consuming because of PCE is a very difficult question to answer for two primary reasons: 1) the program has been in place for several decades and there are no residential customers in PCE communities who are not eligible for the PCE program to enable a comparison. 2) There are no household level data that enable estimation of the actual differences caused by the subsidy.

Figure 9. Seasonal changes of electricity consumption in PCE communities, CY 2009[22]



Source: PCE monthly program data CY 2010 and authors' calculations.

The most likely explanation for why consumption levels are significantly lower than the eligibility cap and so unresponsive to price changes over such a large price range is that the income effect on consumption overwhelms the price effect.[23] In other words, customers can not afford to consume any more electricity even at the PCE effective rates because their incomes are insufficient. These price and income effects also seem to have a compounding effect because communities with the highest electric rates also tend to be the smallest and most remote communities that have the lowest average incomes (see appendix G for information on median household incomes and electric rates).

Customer responsiveness to price changes

In order to analyze potential effects from modifying electricity pricing structures, it is important to understand how changes in prices may lead consumers to increase or decrease their electricity consumption. Price and income elasticity of demand are very important when formulating or re-structuring pricing policies (Narayan & Smyth, 2005). Economic theory tells us that more of a good is consumed as prices decline; conversely if prices increase, consumption declines. In the economics discipline, the concept of Price Elasticity of Demand (PED) measures the proportionate change in quantity consumed of a good in response to a proportionate change in the good's own price (Nicholson & Snyder, 2008).

[22] This figure is based on discrete data and the lines do not represent a functional relationship between consumption and price, but the lines help visualize seasonal differences.

[23] A change in the demand of a good or service, induced by a change in the consumers' discretionary income. Any increase or decrease in price correspondingly decreases or increases consumers' discretionary income. The price of electricity reduces the amount of discretionary income available to purchase more electricity to the extent that there is no discretionary income available to purchase more electricity even if prices decline.

Traditionally, economists have used econometrics methods to estimate the price elasticity of goods. However, measuring PED of electricity for Alaska is particularly challenging because detail customer data is required and the prices/ rates of residential customers are subsidized by the PCE program –the first 500 kWh per customer per month are a significantly lower price than any consumption above the cap. This not only means that different prices are paid for different levels of consumption but that consumer behavior factors these two different prices into their purchasing patterns—meaning that the higher price above the cap affects consumption for the kWh below the cap and that kWh consumed above the cap are affected by the consumption and prices below the cap. In most communities, there is a large discontinuity between the price above the cap, which is much higher than the price below the cap so most residential customers adjust their consumption even if they are below the cap to avoid going over the cap. Being able to account for this relationship is very important but requires a complex and sophisticated econometric model and detailed customer data.

Current availability of public data of electricity rates and consumption is limited mostly to PCE program data which is aggregated at the community level. In addition, because factors other than price also have significant effects on the levels of consumption of residential customers, the econometric model must control for as many of this factors as possible. Commonly these factors include income, household size, temperature, population, and prices of household appliances among others. However, in practice as a result of data constraints, most studies fall short of the optimal comprehensive empirical specification; typically electricity consumption is represented as a function of price, income, population and temperature (Narayan & Smyth, 2005). Data availability is very limited regarding these types of characteristics for PCE communities and/or customers over time.

Given data limitations a preliminary study of the PED in PCE communities shows that electricity consumption in PCE communities is highly price inelastic[24] (Villalobos Melendez, 2012). However, this study measures short term marginal changes at the mean in PCE communities. Although this provides helpful information about price sensitivity of electricity in PCE communities, to conduct an appropriate policy analysis of a postage stamp rate in Alaska requires PED information at the customer level and in the long run. This is a critical consideration because based on economic literature we know that "short-run elasticities are much smaller than long-run elasticities" (Narayan & Smyth, 2005). Because a major change in pricing structure such as a postage stamp rate has long-term implications, we should expect that in the long-run changes in consumption would be likely and significantly higher than those in the short term. We essentially use a "work around" for these data limitations by analyzing the electricity consumption characteristics of PCE communities with electric rates similar to potential All-Alaska Rates.

As noted in the previous section the North Slope Borough (NSB) communities enjoy the lowest effective rates among PCE communities due to natural gas availability and economic assistance provided by both the NSB and the PCE program. In addition, NSB communities have average comparable levels of income (about 5% smaller) than the average income in PCE communities. Hence, consumption patterns in NSB communities provide important empirical evidence of what residential customers in other PCE

[24] Appendix B describes the data sources, methodology and econometric model used to measure PED. It also provides scenarios of potential short term outcomes from adopting a postage stamp rate in Alaska.

communities may be expected to consume in the long run if their effective rates were to decrease to the price levels NSB communities currently pay (about 14 cents/kWh).

All-Alaska Rate

Essentially most electric power generation in Alaska is subsidized; what varies is the extent and the mechanisms. Some are more transparent such as the Power Cost Equalization program. Others are less visible such as energy project financing that writes down construction debt. In addition to economies of scale and rural remoteness, some of the variability in electric rates is a reflection of the luck of proximity to resources and energy projects. Timing is also a factor with the ability to be "in the front of the line" with programs and projects when oil prices and state expenditures are high. The concept of an All-Alaska Rate stems from the idea of allowing all Alaskans to share more equitably in the benefits of proximity, timing and subsidies. The mechanism is to charge an All-Alaska Rate to all rate payers.

We tested this concept of an All-Alaska Rate at two different price levels or postage stamp rates, $0.14 and $0.20. These rates are the current electric kWh rates in Anchorage ($0.14) and average statewide ($0.20) rate which is also the average statewide effective PCE rate (Fay, Villalobos, Gerd 2010; Fay and Villalobos 2011).

Because no long-term measure of the price elasticity of demand is available at the customer level, we base the analysis presented below on empirical evidence from PCE communities that currently pay lower prices. We applied the rates in a mechanism where only those with higher rates pay the new lower rate. Below we describe the assumptions use in the analysis:

- Only rates above the postage stamp rate change.
- Residential rates reflect all costs of producing electricity in a community.
- Consumptions effects are evaluated in the long run based on an empirical review of consumption in NSB communities, which on average have about 31% lower rates and consume about 66% more than PCE communities.
- The postage stamp rate is only available for the first 500 kWh; any consumption above the cap has a price equal to the current residential rate.
- Changes in prices are measure against current effective rates
- Consumption changes are measured based on their relationship with simple changes in prices. No adjustments to consumption are made give the price discontinuity.[25]

Table 5 shows the results of the $0.14 and $0.20 rate scenarios. The table shows the current conditions before applying the All-Alaska Rate including kWh consumption, revenues, population affected and the current cost to the State of providing PCE disbursements in CY 2010.

If only ratepayers paying higher rates are affected, under an All-Alaska Rate set at $0.14 means that PCE utilities would have their rates change (-37% on average) and non-PCE utilities would have their rates change (-25% on average). In PCE communities, approximately 25,500 customers are affected by the

[25] This results in an overestimation of consumption.

rate change while in non-PCE communities, approximately 72,000 customers are affected. The rate change is estimated to result in a 55% increase in kWh consumption in PCE communities and a 14% increase in kWh consumption in non-PCE communities.

As the rates and consumption change, utility revenues also change; PCE utilities collect 68% more revenue while non-PCE communities collect 12% more revenue. However, costs also increase about 62% for PCE utilities and 12% for non-PCE communities. This requires additional payments to utilities to make up the difference--$15.1 million to PCE utilities and $21 million to non-PCE utilities. The total disbursements for all affected utilities would be $62.5 million or a $36.5 million (57%) increase in costs of the program.

Table 5. All-Alaska Rate program long-run scenario at $0.14 and $0.20 per kWh

	PCE	Non PCE	PCE	Non PCE
Total # of communities/utilities	*169*	*14*	*169*	*14*
Population	*75,985*	*408,342*	*75,985*	*408,342*
Total kWh before All-Alaska rate	*117,897,443*	*1,966,507,000*	*117,897,443*	*1,966,507,000*
Base total cost	$51,500,000	$284,800,000	$51,500,000	$284,800,000
Base total revenue	$25,200,000	$284,800,000	$25,200,000	$284,800,000
Base total disbursements	$26,300,000		$26,300,000	
All- Alaska rate @	***$0.14***	***$0.14***	**$0.20**	**$0.20**
# utilities/communities with lower effective rate	8	9	65	12
% utilities/communities with lower effective rate	5%	64%	38%	86%
		if only higher rates change		
Total kWh after All-Alaska rate	182,354,824	2,247,777,120	135,742,511	1,976,231,386
Average % consumption change	55%	14%	15%	0%
		in affected communities		
Average % change in rate	-37%	-25%	-26%	-5%
Total number customers affected	25,521	72,426	12,370	40,475
Total cost after	83,700,000	339,300,000	61,800,000	286,800,000
Total revenue after	$42,200,000	$318,200,000	$29,400,000	$286,000,000
Total disbursements after	$41,500,000	$21,000,000	$32,400,000	$800,000
Additional disbursements	$15,100,000	$21,000,000	$6,100,000	$800,000
Change in disbursements	57%		23%	
Total disbursements to all communities	$62,500,000		$33,300,000	

Note: Scenario represents estimates based on available PCE data. Figures shown in italic font represent values based on actual data.

If the All-Alaska Rate is set at $0.20 per kWh, 65 PCE communities have lower effective rates and 12 non-PCE utilities have lower rates. If only ratepayers paying higher rates are affected, under an All-Alaska Rate set at $0.20 the PCE utilities would have their rates change (-26% on average) and non-PCE utilities would have their rates change (-5% on average). In PCE communities, approximately 12,000 customers are affected by the rate change while in non-PCE communities, approximately 40,500 customers are affected. The rate change is estimated to result in a 26% increase in kWh consumption in PCE communities and a 5% change in kWh consumption in non-PCE communities.

As rates and consumption change, utility revenues also change; PCE utilities collect 17% more revenue while non-PCE communities see no change in revenue. Total costs also increase about an estimated 20% for PCE utilities and about 1% in non-PCE communities. This requires additional payments to PCE utilities--$6.1 million-- to make up the difference and about $0.8 million in additional payments to non-PCE utilities. The total disbursements for all affected utilities would be $33.3 million meaning no effective change compared to current PCE program costs.

Another potential scenario is the implementation of a regional rate. For example, in Southeast Alaska there are a number of communities with hydroelectric facilities paying rates substantially less than communities using diesel to generated electricity. An incremental increase of about 2.4 cents in rates paid in communities that benefited from partially publically funded hydroelectric projects could equalize the rates paid in all the other communities with diesel generation to $0.10 (Table 6). This is also substantially less costly than building additional hydroelectric facilities and transmission lines,[26] would remove all Southeast communities from the PCE program, and more equitably distribute public subsidies in the region.

Table 6. Southeast Alaska regional scenario

PCE Communities Southeast Region	CY2010	CY2009
Total # of communities	*20*	*20*
Total kWh before All AK rate	*23,339,991*	*25,329,416*
Base total cost	*$7,400,000*	*$7,600,000*
Base total revenue	$4,100,000	$4,500,000
Base total disbursements	$3,300,000	$3,100,000
Total kWh after regional rate	42,496,095	46,128,855
Average % consumption change	82%	82%
Average % change in rate	-46%	-46%
Total number of customers affected	5,340	5,211
Total cost after	$13,900,000	$14,400,000
Total revenue after	$4,200,000	$7,800,000
Total disbursements after	$6,700,000	$6,600,000
Additional Disbursements	$3,400,000	$3,500,000
Change in disbursements	104%	113%
Funds required	$6,700,000	$6,600,000
kWh sold to Non PCE SE communities	283,229,000	289,057,000
Rate increase/kWh to Non-PCE SE communities	**$0.024**	**$0.023**

Note: Scenario represents estimates based on available PCE data. Figures shown in italic font represent values based on actual data.

[26] Black and Veatch, 2011, *Southeast Alaska Integrated Resource Plan*, prepared for the Alaska Energy Authority. http://www.akenergyauthority.org/SEIRP/12-23-2011_Vol1_SoutheastAlaskaIRP.pdf

Infrastructure costs

What are not included in this analysis are potential costs of infrastructure that would be required to meet the growth in demand in PCE communities under the new All-Alaska Rates. In order to calculate these potential costs, more information is needed on the current generation and distribution capacity in each community and the extent to which this infrastructure could accommodate growth in demand, which in both scenarios is substantial. While demand growth in PCE communities is estimated to increase substantially, energy efficiency end use measures could potentially be used to meet approximately half of the increase based on energy efficiency studies completed by the Alaska Energy Authority.[27]

It is important to evaluate a "everyone pays" the rate option where people who currently enjoy lower rates help pay the cost of the new more equitable rates. In most cases, electric customers paying rates lower than $0.14 per kWh are doing so because of construction subsidies for hydroelectric projects and sale of the projects for less than their full costs to utilities. Under a $0.14 rate, these rate payers would still be paying lower rates than the true costs of the power they are consuming. The "everyone pays" scenario also results in ratepayers helping to shoulder a larger share of the costs of power production. A potential result of this approach is greater citizen engagement in state energy policy and financing as well as improved allocation of energy resources.[28] However, to appropriately evaluate a scenario like that a long-run price elasticity of demand is required. As additional and more disaggregated data becomes available, it may allow a more accurate estimation and evaluation of potential scenarios in which a postage stamp rate could be implemented. Given that Susitna hydroelectric power may cost $0.30+ per kWh (2011$) but may be financed to pay down rates to current Anchorage levels, provides an opportunity to more fully evaluate an All-Alaska Rate.

[27] Butler, G. (2010). *Nightmute Final Report Lighting & Weatherization Measures 2008 – 2009*, Alaska Building Science Network, prepared for the Alaska Energy Authority.

[28] See Black and Veatch, 2011, Southeast Alaska Integrated Resource Plan, Executive Summary, 1-4, Space Heating discussion. http://www.akenergyauthority.org/SEIRP/12-23-2011_Vol1_SoutheastAlaskaIRP.pdf

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Appendix A. Price elasticity of demand in PCE communities

Measuring PED of electricity for Alaska is particularly challenging because the prices/ rates of residential customers are subsidized by the PCE program –the first 500 kWh per customer per month are a significantly lower rate than any consumption above the cap. This not only means that different rates are paid for different levels of consumption but that consumer behavior factors this two different prices into their purchasing patterns—meaning that the higher price above the cap affects consumption for the kWh below the cap and that kWh consumed above the cap are affected by the consumption and prices below the cap. In most communities, there is a large discontinuity between the price above the cap, which is much higher than the price below the cap so most residential customers adjust their consumption even if they are below the cap to avoid cross over and going over the cap. Being able to account for this relationship is very important but requires a complex and sophisticated econometric model. In addition data availability and data limitations hinder possibilities for appropriate analysis. These limitations include price and consumption public data that is too aggregated for analysis at the community level. This results in measurement of marginal changes over the average and because the average is a measure that has already greatly smoothed variability across customers there is limited insight that can be derived of how the customer consumption patterns may change.

In addition, information regarding other factors (e.g. income, household size, prices and use of household appliances) that affect consumption is needed. Although some information may be available for Alaska communities/customers even when data is available is often too aggregated, estimates with large margins of error or not available consistently over time.

Given data limitations a preliminary study of the PED in PCE communities shows that electricity consumption in PCE communities is highly price inelastic[29] (Villalobos Melendez, 2012). These preliminary estimates show that as expected short-run price elasticity of demand for PCE communities in Alaska is highly inelastic, for every 1% change in price a 0.034% change in consumption should be expected. In lay terms for every change in price a very small change in consumption is expected. However, it is important to note that this model does not distinguish the difference between short-run and long-run elasticity. This is a critical consideration because based on economic literature we know that “short-run elasticities are much smaller than long-run elasticities” (Narayan & Smyth, 2005). Because a major change in pricing structure such as a postage stamp rate has long term implications, we should expect that in the long run changes in consumption would be likely and significantly higher than those estimated in this analysis.

Below Table 9 shows short-run estimates of adopting a postage stamp rate in Alaska are presented although the reader must keep in mind that policy changes should be based on the expected long term effects.

[29] For details on how price elasticity of demand for PCE communities was measured and implications please see Villalobos Melendez, A. (2012, May-forthcoming). *Aligning Electricity Energy Policies in Alaska: Analysis of the Power Cost Equalization and Renewable Energy Fund Programs* (Master's thesis). Fairbanks, Alaska: University of Alaska Fairbanks.

Table 7. All-Alaska rate program short-run scenario at $0.14 and $0.20 per kWh

	PCE	Non PCE	PCE	Non PCE
Total # of communities/utilities	*169*	*14*	*169*	*14*
Population	*75,985*	*408,342*	*75,985*	*408,342*
Total kWh before All-Alaska rate	*117,897,443*	*1,966,507,000*	*117,897,443*	*1,966,507,000*
Base total cost	$51,500,000	$284,800,000	$51,500,000	284,800,000
Base total revenue	$25,200,000	-	$25,200,000	-
Base total disbursements	$26,300,000		$26,300,000	
All- Alaska rate @	***$0.14***	***$0.14***	**$0.20**	**$0.20**
# utilities/communities with lower effective rate	8	9	65	12
% utilities/communities with lower effective rate	5%	64%	38%	86%
		If all rates change		
Total kWh after All-Alaska rate	119,000,000	1,879,600,000	117,700,000	1,852,100,000
Average % consumption change	1%	-4%	-0.2%	-6%
Average % change in rate	-33%	10%	-5%	58%
Total number customers affected	25,630	246,960	12,370	246,960
Total cost after	$52,100,000	$273,800,000	$51,600,000	$270,000,000
Total revenue after	$18,100,000	$264,300,000	$24,500,000	$349,400,000
Total disbursements after	$33,900,000	$9,500,000	$27,000,000	-$79,400,000
Additional disbursements	$7,100,000	$9,500,000	$700,000	
Change in disbursements	27%		2%	
Total disbursements to all communities	$43,400,000		-$52,400,000	
		if only higher rates change		
Total kWh after All-Alaska rate	119,000,000	1,971,300,000	118,200,000	1,966,700,000
Average % consumption change	1%	0%	0.3%	0%
		in affected communities		
Average % change in rate	-37%	-25%	-26%	-5%
Total number customers affected	25,520	72,430	11,280	40,480
Total cost after	$52,100,000	$285,700,000	$51,700,000	$284,800,000
Total revenue after	$16,900,000	$258,500,000	$22,700,000	$227,900,000
Total disbursements after	$35,100,000	$27,200,000	$29,000,000	$56,900,000
Additional disbursements	$8,800,000	$27,200,000	$2,700,000	$56,900,000

Change in disbursements	33%	10%
Total disbursements to all communities	$62,300,000	$85,900,000

Because PCE communities have very inelastic price elasticity of demand for electricity, changes in prices are not likely to result in large consumption changes in the short-run. Even without large changes in consumption a postage stamp rate is likely to result in need of larger disbursements to utilities/communities. The only scenario in which no disbursements are need is one where the postage stamp rate is set to $0.20 and customers with currently lower rates experience price increases while customers with higher rates experience price decreases. Because consumption in the short-run changes by very small amounts that lead into a high increase in revenues as non-PCE communities would have an average increase of about 58%. However, it is likely that over the long run, urban customers would decrease their consumption resulting in lower revenue.

Appendix B. PCE funding levels per year

Program	Fiscal Year	Average Annual PCE Funding Level	PCE Funding Level Detail							
			PCE Level	No. of Months	PCE Level	No. of Months	PCE Level	No. of Months	PCE Level	No. of Months
PPCA	1981	100.00%	100%	12						
PCA	1982	100.00%	100%	12						
PCA	1983	100.00%	100%	12						
PCA	1984	100.00%	100%	12						
PCA PCE	1985	100.00%	100%	12						
PCE	1986	100.00%	100%	12						
PCE	1987	100.00%	100%	12						
PCE	1988	100.00%	100%	12						
PCE	1989	100.00%	100%	12						
PCE	1990	100.00%	100%	12						
PCE	1991	100.00%	100%	12						
PCE	1992	81.67%	100%	1	80%	11				
PCE	1993	89.17%	80%	1	90%	11				
PCE	1994	95.00%	90%	2	95%	8	100%	2		
PCE	1995	97.50%	100%	10	85%	2				
PCE	1996	97.50%	85%	2	100%	10				
PCE	1997	85.00%	85%	12						
PCE	1998	85.00%	85%	12						
PCE	1999	83.08%	85%	10	73.5%	2				
PCE	2000	100.00%	100%	12						
PCE	2001	97.83%	100%	11	74%	1				
PCE	2002	80.33%	92%	7	80%	4	66%	1		
PCE	2003	86.17%	84%	8	90%	3	92%	1		
PCE	2004	82.25%	92%	3	83%	6	75%	2	63%	1
PCE	2005	72.08%	81%	2	76%	5	65%	4	63%	1
PCE	2006	88.17%	81%	4	78%	3	100%	5		
PCE	2007	94.50%	100%	6	89%	6				
PCE	2008	100.00%	100%	12						
PCE	2009	100.00%	100%	12						
PCE	2010	100.00%	100%	12						

Source: Statistical Reports of the Power Cost Equalization Program 1988-2010

Appendix C. PCE appropriations and disbursements over time

Program	Fiscal Year	Appropriations ($)	Total Disbursements ($)
PPCA	1981	2,657,600	2,183,168
PCA	1982	9,300,000	6,419,408
PCA	1983	8,300,000	8,327,152
PCA	1984	8,300,000	8,740,820
PCA/PCE	1985	19,100,000	13,800,868
PCE	1986	21,700,000	17,785,390
PCE	1987	13,840,299	16,771,338
PCE	1988	15,067,900	17,018,680
PCE	1989	19,724,000	17,104,631
PCE	1990	16,814,000	17,785,256
PCE	1991	16,912,100	19,607,435
PCE	1992	15,029,700	15,731,165
PCE	1993	18,026,700	17,341,042
PCE	1994	17,920,000	17,516,024
PCE	1995	18,635,000	18,493,448
PCE	1996	19,385,600	19,201,515
PCE	1997	18,500,000	17,906,275
PCE	1998	18,700,000	18,503,992
PCE	1999	18,050,000	17,949,524
PCE	2000	15,700,000	14,415,676
PCE	2001	17,090,222	17,076,203
PCE	2002	15,700,000	15,469,105
PCE	2003	15,700,000	15,448,480
PCE	2004	15,700,000	15,617,225
PCE	2005	15,700,000	15,370,599
PCE	2006	22,020,000	21,494,137
PCE	2007	25,619,000	25,437,093
PCE	2008	28,560,000	28,137,549
PCE	2009	38,500,000	37,029,584
PCE	2010	37,660,000	30,627,339
PCE	2011		

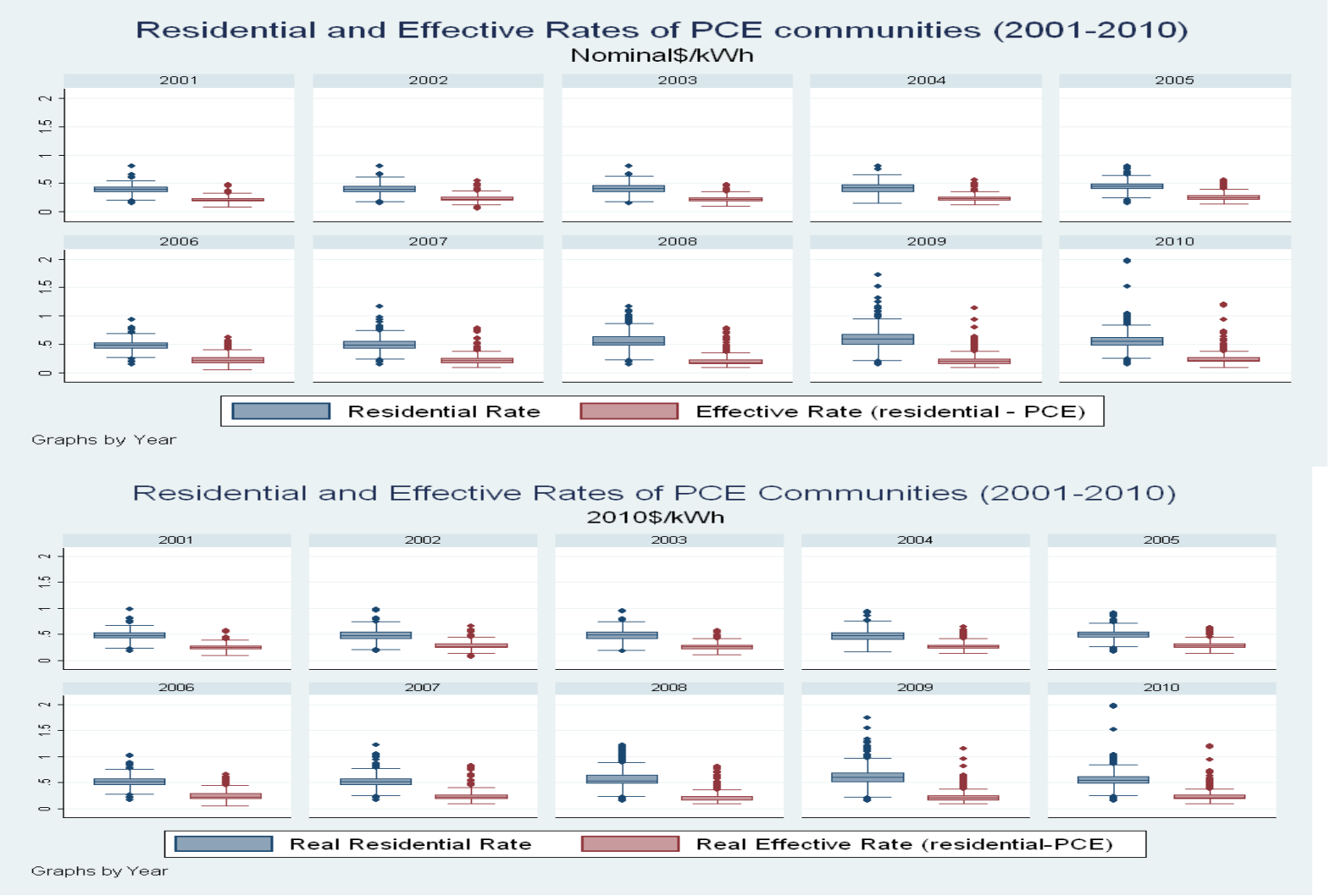
Appendix D. Communities/Locations in the Railbelt region

Utility	Community/Location
Chugach Electric Association, Inc.	Anchorage
Chugach Electric Association, Inc.	Beluga
Chugach Electric Association, Inc.	Cooper Landing
Chugach Electric Association, Inc.	Girdwood
Chugach Electric Association, Inc.	Hope
Chugach Electric Association, Inc.	Moose Pass
Chugach Electric Association, Inc.	Sunrise
Chugach Electric Association, Inc.	Tyonek
Chugach Electric Association, Inc.	Whittier
Copper Valley Electric Assn.	Lake Louise
Copper Valley Electric Assn.	Nelchina
Golden Valley Electric Association, Inc.	Cantwell
Golden Valley Electric Association, Inc.	Chase
Golden Valley Electric Association, Inc.	College
Golden Valley Electric Association, Inc.	Crown Point
Golden Valley Electric Association, Inc.	Delta Junction
Golden Valley Electric Association, Inc.	Deltana
Golden Valley Electric Association, Inc.	Denali Borough
Golden Valley Electric Association, Inc.	Eielson AFB
Golden Valley Electric Association, Inc.	Fairbanks
Golden Valley Electric Association, Inc.	Farm Loop
Golden Valley Electric Association, Inc.	Ferry
Golden Valley Electric Association, Inc.	Fishhook
Golden Valley Electric Association, Inc.	Fox
Golden Valley Electric Association, Inc.	Harding-Birch Lakes
Golden Valley Electric Association, Inc.	Healy
Golden Valley Electric Association, Inc.	McKinley Park
Golden Valley Electric Association,	Moose Creek

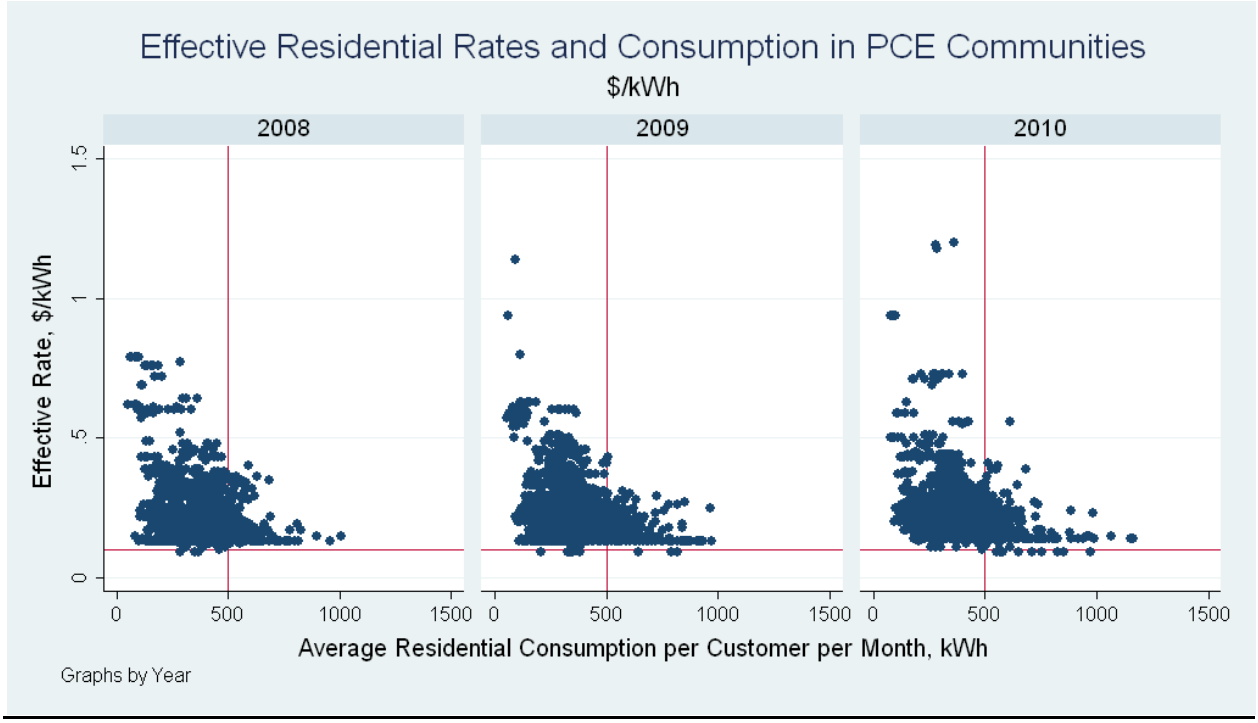
Utility	Community/Location
Inc.	
Golden Valley Electric Association, Inc.	Pleasant Valley
Golden Valley Electric Association, Inc.	Salcha
Golden Valley Electric Association, Inc.	Two Rivers
Homer Electric Association, Inc.	Anchor Point
Homer Electric Association, Inc.	Clam Gulch
Homer Electric Association, Inc.	Cohoe
Homer Electric Association, Inc.	Diamond Ridge
Homer Electric Association, Inc.	Fox River
Homer Electric Association, Inc.	Fritz Creek
Homer Electric Association, Inc.	Funny River
Homer Electric Association, Inc.	Halibut Cove
Homer Electric Association, Inc.	Happy Valley
Homer Electric Association, Inc.	Homer
Homer Electric Association, Inc.	Jakolof Bay
Homer Electric Association, Inc.	Kachemak
Homer Electric Association, Inc.	Kalifornsky
Homer Electric Association, Inc.	Kasilof
Homer Electric Association, Inc.	Kenai
Homer Electric Association, Inc.	Miller Landing
Homer Electric Association, Inc.	Nanwalek
Homer Electric Association, Inc.	Nikiski
Homer Electric Association, Inc.	Nikolaevsk
Homer Electric Association, Inc.	Ninilchik
Homer Electric Association, Inc.	Port Graham
Homer Electric Association, Inc.	Ridgeway
Homer Electric Association, Inc.	Salamatof
Homer Electric Association, Inc.	Seldovia
Homer Electric Association, Inc.	Seldovia Village
Homer Electric Association, Inc.	Soldotna
Homer Electric Association, Inc.	Sterling
Matanuska Electric Association, Inc.	Big Lake
Matanuska Electric Association, Inc.	Buffalo Soapstone
Matanuska Electric Association, Inc.	Butte
Matanuska Electric Association, Inc.	Chickaloon
Matanuska Electric Association, Inc.	Eagle River-Chugiak
Matanuska Electric Association, Inc.	Eklutna
Matanuska Electric Association, Inc.	Gateway
Matanuska Electric Association, Inc.	Glacier View

Utility	Community/Location
Matanuska Electric Association, Inc.	Houston
Matanuska Electric Association, Inc.	Knik River
Matanuska Electric Association, Inc.	Knik-Fairview
Matanuska Electric Association, Inc.	Lakes
Matanuska Electric Association, Inc.	Lazy Mountain
Matanuska Electric Association, Inc.	Meadow Lakes
Matanuska Electric Association, Inc.	Palmer
Matanuska Electric Association, Inc.	Petersville
Matanuska Electric Association, Inc.	Point MacKenzie
Matanuska Electric Association, Inc.	Skwentna
Matanuska Electric Association, Inc.	Susitna
Matanuska Electric Association, Inc.	Sutton-Alpine
Matanuska Electric Association, Inc.	Talkeetna
Matanuska Electric Association, Inc.	Tanaina
Matanuska Electric Association, Inc.	Trapper Creek
Matanuska Electric Association, Inc.	Wasilla
Matanuska Electric Association, Inc.	Willow
Matanuska Electric Association, Inc.	Y
Seward Electric System	Bear Creek
Seward Electric System	Lowell Point
Seward Electric System	Primrose
Seward Electric System	Seward
	Big Delta
	Ester

Appendix E. Residential and effective rates of PCE communities, 2001-2010



Appendix F. Effective residential rates and consumption of electricity in PCE communities, 2008-2010



Appendix G. PCE communities characteristics of importance as factors of electricity production and demand[30]

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
Adak	Aleutians West (CA)	0.73	0.23	3.55	5.47	258	105	2*	64453.64*
Akiachak	Bethel (CA)	0.64	0.24	3.72	15.05	306	624	4	41459.293
Akiak	Bethel (CA)	0.64	0.32	4.55	12.45	238	339	4	30371.625
Akutan	Aleutians East	0.33	0.14	3.22	8.89	394	812	2	39049.232
Alakanuk	Wade Hampton (CA)	0.63	0.20	3.90	13.55	417	695	5	30482.699
Allakaket	Yukon-Koyukuk (CA)	0.71	0.19	4.38	13.56	237	105	2*	23824.11*
Ambler	Northwest Arctic	0.76	0.21	4.47	14.13	398	258	4	50330.122
Anaktuvuk Pass	North Slope	0.16	0.14	5.20	11.52	604	309	3	60743.25
Angoon	Hoonah-Angoon (CA)								34549.604

[30] Income and household data are originally sourced from the Internal Revenue Service for the Viable Business Enterprises for Rural Alaska project by ISER and other partners (http://ced.uaa.alaska.edu/vibes/VIBESsummary.pdf). The Income and household data represent calendar year of 2004 and adjusted to 2010 dollars. Although more recent data is available through the U.S. Census Bureau America Community Survey (ACS), we present older data because we believe it is more accurate. ACS data is available as a 5 year average and is the result extrapolation of sampled data. However, due to the challenges of small samples in Alaska, ACS tends to have very large margin of errors severely limiting its value. When data from the VIBES project was not available, ACS data is presented; this is indicated by the asterisks next to the data point.

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		0.48	0.20	2.78	14.08	412	450	3	
Aniak	Bethel (CA)	0.75	0.27	3.62	13.39	452	494	3	48449.974
Anvik	Yukon-Koyukuk (CA)	0.68	0.19	4.17	11.92	327	72	3	24586.554
Atka	Aleutians West (CA)	0.71	0.24	4.19	10.79	395	63	3	35795.708
Atmautluak	Bethel (CA)	0.78	0.37	3.59	6.98	340	269	5	43870.511
Atqasuk	North Slope	0.19	0.18	3.00	8.39	783	212	4	77065.251
Beaver	Yukon-Koyukuk (CA)	0.56	0.14	3.80		195	73	3	33264.161
Bethel	Bethel (CA)	0.50	0.16	5.05	13.76	505	5,966	3	66321.216
Bettles	Yukon-Koyukuk (CA)	0.62	0.19	2.65	12.13	382	13	3	57127.581
Brevig Mission	Nome (CA)	0.60	0.19	4.00	14.21	418	358	4	25309.688
Buckland	Northwest Arctic	0.53	0.23	5.00	11.42	523	392	5	44351.829
Central	Yukon-Koyukuk (CA)	0.61	0.31	2.27	10.82	167	96	2*	14278.33*
Chalkyitsik	Yukon-Koyukuk (CA)	0.97	0.59	4.18	10.59	123	71	2	18801.482
Chefornak	Bethel (CA)	0.64	0.26	4.13	12.95	424	430	5	41138.8
Chenega Bay	Valdez-Cordova (CA)								62189.518

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		0.47	0.17	3.30	6.64	343	80	4	
Chevak	Wade Hampton (CA)	0.66	0.19	4.03	12.87	430	931	5	31094.759
Chignik	Lake and Peninsula	0.52	0.18	2.75	11.34	286	84	3	39627.74
Chignik Lagoon	Lake and Peninsula	0.45	0.15	3.93	11.60	428	82	3	106788.95
Chignik Lake	Lake and Peninsula	0.59	0.19	2.80		316	77	4	47967.499
Chilkat Valley	Haines	0.48	0.20	3.20		292			43855.27*
Chistochina	Valdez-Cordova (CA)	0.52	0.19	2.31	11.50	292	93	2*	47040.7*
Chitina	Valdez-Cordova (CA)	0.55	0.25	2.73	13.25	277	133	2*	12763.1*
Chuathbaluk	Bethel (CA)	1.01	0.26	5.15	11.53	217	107	4	39669.392
Circle	Yukon-Koyukuk (CA)	0.68	0.19	2.43	10.63	300	115	2*	15060.46*
Coffman Cove	Prince of Wales-Hyder (CA)	0.43	0.18	2.51	13.31	306	207	3	50619.375
Cold Bay	Aleutians East	0.63	0.18	3.65	13.54	405	110	2	64503.547
Cordova	Valdez-Cordova (CA)	0.34	0.24	2.23	13.40	517	2,266	2	57982.614
Craig	Prince of Wales-Hyder (CA)	0.21	0.16	2.30	10.36	504	1,194	3	52410.433
Crooked Creek	Bethel (CA)								20247.75

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		1.01	0.26	5.25	11.77	282	106	4	
Deering	Northwest Arctic	0.78	0.35	4.71	12.64	381	126	3	38566.757
Dillingham	Dillingham (CA)	0.44	0.16	3.60	15.20	475	2,245	3	59537.642
Diomede	Nome (CA)	0.61	0.14	5.85	9.88	258	118	3	27479.089
Dot Lake	Southeast Fairbanks (CA)	0.33	0.17	2.08		344	8	1*	38461.75*
Eagle	Southeast Fairbanks (CA)	0.63	0.19	2.88	12.30	209	82	2*	25047.32*
Eek	Bethel (CA)	0.69	0.20	3.83	12.03	269	283	4	20247.75
Egegik	Lake and Peninsula	0.93	0.36	4.30	9.62	265	73	3	53222.657
Ekwok	Dillingham (CA)	0.51	0.14	3.70		338	117	3	18801.482
Elfin Cove	Hoonah-Angoon (CA)	0.57	0.18	4.42	12.86	182	23	2	39049.232
Elim	Nome (CA)	0.61	0.19	4.07	13.67	393	302	4	46487.677
Emmonak	Wade Hampton (CA)	0.64	0.20	3.90	13.51	442	766	4	38085.439
Fort Yukon	Yukon-Koyukuk (CA)	0.61	0.22	3.78	14.12	275	604	3	33987.295
Galena	Yukon-Koyukuk (CA)	0.57	0.23	4.30	13.03	365	539	3	70722.499
Gambell	Nome (CA)								36397.356

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		0.62	0.19	3.93	13.38	370	680	4	
Golovin	Nome (CA)	0.71	0.19	5.10	12.23	319	154	3	36879.831
Goodnews Bay	Bethel (CA)	0.64	0.20	3.83	12.91	352	247	3	18801.482
Grayling	Yukon-Koyukuk (CA)	0.71	0.21	4.17	11.83	294	182	4	25309.688
Gustavus	Hoonah-Angoon (CA)	0.58	0.28	2.71	15.47	159	464	2	40224.759
Haines	Haines	0.21	0.15	3.13	13.24	450	1,673	2*	44877.09*
Healy Lake	Southeast Fairbanks (CA)	0.66	0.24	2.53	9.43	269	8	2*	112953.4*
Hollis	Prince of Wales-Hyder (CA)	0.21	0.16	2.80		401	118	2*	27866.44*
Holy Cross	Yukon-Koyukuk (CA)	0.68	0.19	4.10	12.63	322	186	4	25309.688
Hoonah	Hoonah-Angoon (CA)	0.48	0.20	2.40	14.27	424	762	3	45155.954
Hooper Bay	Wade Hampton (CA)	0.62	0.19	4.00	13.53	338	1,054	4	30854.1
Hughes	Yukon-Koyukuk (CA)	0.72	0.34	4.45	12.76	291	71	3	28202.223
Huslia	Yukon-Koyukuk (CA)	0.64	0.20	4.13		403	267	3	31239.386
Hydaburg	Prince of Wales-Hyder (CA)	0.21	0.16	2.88	(3.84)	505	386	3	36590.577
Igiugig	Lake and Peninsula								25165.061

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		0.75	0.17	6.33	10.65	314	39	3	
Kake	Petersburg (CA)	0.48	0.20	2.71	13.34	374	578	3	45867.518
Kaktovik	North Slope	0.18	0.16	3.70	15.78	662	245	3	64358.92
Kalskag	Bethel (CA)	0.60	0.19	3.97	13.42	396	196	4	32781.686
Kaltag	Yukon-Koyukuk (CA)	0.64	0.19	4.03	14.23	338	187	3	33746.636
Karluk	Kodiak Island	0.61	0.14	3.58	11.55	470	38	3	22176.493
Kasigluk	Bethel (CA)	0.55	0.18	3.97	13.53	452	548	5	36445.95
Kiana	Northwest Arctic	0.69	0.19	4.40	12.75	423	356	4	45919.583
King Cove	Aleutians East	0.25	0.15	2.36	11.13	425	824	3	53098.857
Kipnuk	Bethel (CA)	0.65	0.26	3.65	6.37	416	640	5	39772.366
Kivalina	Northwest Arctic	0.71	0.20	4.40	12.78	497	370	5	35674.222
Klawock	Prince of Wales-Hyder (CA)	0.21	0.16	2.85		520	723	3	40495.5
Klukwan	Hoonah-Angoon (CA)	0.48	0.20	3.20		390	76	2*	27760.25*
Kobuk	Northwest Arctic	0.88	0.30			422	133	4	35578.19
Kokhanok	Lake and Peninsula								22657.811

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		0.92	0.27	4.57	12.15	337	170	3	
Koliganek	Dillingham (CA)	0.51	0.14	5.06	8.36	273	185	3	51583.168
Kongiganak	Bethel (CA)	0.56	0.26	4.03	12.72	452	440	5	38470.725
Kotlik	Wade Hampton (CA)	0.59	0.19	3.67	13.57	455	574	5	43677.29
Kotzebue	Northwest Arctic	0.48	0.18	3.94	15.16	650	3,331	3	66138.408
Koyuk	Nome (CA)	0.63	0.19	4.07	13.85	471	338	4	35192.904
Koyukuk	Yukon-Koyukuk (CA)	0.46	0.15	4.00		181	99	3	22417.152
Kwethluk	Bethel (CA)	0.53	0.24	3.73	12.44	292	692	5	29407.832
Kwigillingok	Bethel (CA)	0.51	0.17	3.90	13.23	446	330	5	41941.768
Larsen Bay	Kodiak Island	0.41	0.22	3.59	11.56	301	85	3	47244.365
Levelock	Lake and Peninsula	0.72	0.13	8.50		190	95	3	21694.018
Lime Village	Bethel (CA)	1.27	0.67	8.20	5.62	82	24	1*	14039.41*
Lower Kalskag	Bethel (CA)	0.60	0.19	3.97		299	271	4	29648.491
Manley Hot Springs	Yukon-Koyukuk (CA)	1.05	0.27	2.38	10.83	122	85	4*	76260.02*
Manokotak	Dillingham (CA)								31094.759

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		0.51	0.19	3.88	12.31	334	422	4	
Marshall	Wade Hampton (CA)	0.64	0.20	3.57	14.27	433	396	4	38085.439
McGrath	Yukon-Koyukuk (CA)	0.61	0.17	3.82	13.19	363	327	3	49816.407
Mekoryuk	Bethel (CA)	0.66	0.19	3.70	13.08	270	177	3	35674.222
Mentasta Lake	Valdez-Cordova (CA)	0.53	0.19	2.33	12.35	274	122	3*	22335.42*
Minto	Yukon-Koyukuk (CA)	0.59	0.20	3.47	12.67	327	203	3*	32227.33*
Mountain Village	Wade Hampton (CA)	0.61	0.20	3.93	14.63	428	806	4	36156.697
Naknek	Bristol Bay	0.44	0.17	3.50	15.15	397	545	3	61776.464
Napakiak	Bethel (CA)	0.98	0.25		2.69	307	345	4	33264.161
Napaskiak	Bethel (CA)	0.61	0.18	3.76	8.44	448	410	5	36799.997
Naukati Bay	Prince of Wales-Hyder (CA)	0.45	0.18	2.55	12.27	404	111	2	31817.893
Nelson Lagoon	Aleutians East	0.66	0.27	4.32	11.98	304	58	3	50619.375
New Stuyahok	Dillingham (CA)	0.63	0.19	4.13	12.79	430	510	4	30130.966
Newtok	Bethel (CA)	0.81	0.40	4.68	10.25	308	351	5	37241.976
Nightmute	Bethel (CA)								41580.78

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		0.55	0.18	4.03		447	279	4	
Nikolai	Yukon-Koyukuk (CA)	0.81	0.42	4.83	3.19	359	86	3	17355.214
Nikolski	Aleutians West (CA)	0.61	0.22	4.50	9.72	338	23	3	44834.304
Noatak	Northwest Arctic	0.81	0.19	6.70	13.86	561	490	4	35674.222
Nome	Nome (CA)	0.38	0.20	3.80	15.91	458	3,610	3	68728.963
Nondalton	Lake and Peninsula	0.59	0.28	4.75	11.34	394	162	3	22657.811
Noorvik	Northwest Arctic	0.70	0.20	4.47	11.74	525	619	5	60123.091
Northway	Southeast Fairbanks (CA)	0.49	0.18	2.25	13.66	320	84	3*	36109.36*
Nuiqsut	North Slope	0.17	0.11	3.50	11.90	640	410	4	55578.339
Nulato	Yukon-Koyukuk (CA)	0.63	0.19	3.93	13.72	348	249	4	29057.257
Nunam Iqua	Wade Hampton (CA)	0.54	0.25	3.85	13.15	344	183	5	33553.415
Nunapitchuk	Bethel (CA)	0.55	0.18	3.97		395	483	4	33884.321
Old Harbor	Kodiak Island	0.61	0.19	3.77	13.33	304	219	3	37602.965
Ouzinkie	Kodiak Island	0.40	0.21	3.33	14.06	318	169	3	60743.25
Pedro Bay	Lake and Peninsula								42520.275

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		0.93	0.49	4.65	12.20	289	62	3	
Pelican	Hoonah-Angoon (CA)	0.44	0.16	3.32	12.29	402	112	2	56404.447
Perryville	Lake and Peninsula	0.58	0.43	3.00		300	130	3	60020.116
Pilot Point	Lake and Peninsula	0.51	0.14	4.77	12.82	345	74	3	47726.84
Pilot Station	Wade Hampton (CA)	0.63	0.19	3.80	12.66	423	544	5	35949.591
Pitkas Point	Wade Hampton (CA)	0.62	0.18	3.50		297	92	4	48449.974
Point Hope	North Slope	0.18	0.17	3.70	14.99	796	660	4	73036.527
Point Lay	North Slope	0.16	0.15	3.55	13.24	683	196	4	79544.733
Port Alsworth	Lake and Peninsula	0.66	0.19	4.16	11.80	335	129	3	67974.59
Port Heiden	Lake and Peninsula	0.69	0.36	4.34		283	99	3	36879.831
Quinhagak	Bethel (CA)	0.65	0.20	3.90	13.78	363	680	4	29105.852
Red Devil	Bethel (CA)	1.01	0.26	5.25	8.12	235	33	3	12655.422
Ruby	Yukon-Koyukuk (CA)	0.92	0.58	4.01	4.60	131	162	3	28202.223
Russian Mission	Wade Hampton (CA)	0.63	0.20	3.90	13.87	480	314	4	31817.893
Saint Marys	Wade Hampton (CA)								45557.438

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		0.62	0.18	3.50	14.02	349	548	4	
Saint Michael	Nome (CA)	0.62	0.20	4.00	14.68	532	407	4	38223.124
Saint Paul	Aleutians West (CA)	0.48	0.23	3.63	14.12	537	439	3	58718.475
Sand Point	Aleutians East	0.49	0.21	3.29	13.99	457	1,051	3	64118.261
Savoonga	Nome (CA)	0.59	0.20	3.93	14.20	469	660	4	27118.101
Scammon Bay	Wade Hampton (CA)	0.63	0.19	3.90	13.48	439	474	5	29648.491
Selawik	Northwest Arctic	0.66	0.19	4.47	13.54	475	825	4	29648.491
Shageluk	Yukon-Koyukuk (CA)	0.75	0.20	4.00	11.32	252	91	4	30854.1
Shaktoolik	Nome (CA)	0.61	0.19	3.93	13.81	517	245	4	36879.831
Shishmaref	Nome (CA)	0.60	0.18	4.07	14.48	412	559	4	35536.537
Shungnak	Northwest Arctic	0.71	0.20	4.47	13.51	533	260	5	51342.509
Skagway	Skagway	0.21	0.15	1.93	14.39	467	881	3*	72795.61*
Slana	Valdez-Cordova (CA)	0.53	0.19	2.36	12.86	281	141	3*	46106.44*
Sleetmute	Bethel (CA)	1.01	0.26	5.25	10.54	245	77	3	17355.214
Stebbins	Nome (CA)								26755.956

Community Name	Census Region	Residential Rate 2010$ per kWh	Effective Rate 2010$ per kWh	Fuel Prices 2010$ per gallon	kWh per gallon	Average Residential Monthly Consumption	Population	Average Household Income, 2004 (2010$$)	Median Income(2004)* 2010$
		0.62	0.19	3.90	13.29	347	574	4	
Stevens Village	Yukon-Koyukuk (CA)	1.10	0.63	5.20	10.99	102	86	3*	42713*
Stony River	Bethel (CA)	1.01	0.26	5.30	9.64	145	47	2*	11486.79*
Takotna	Yukon-Koyukuk (CA)	1.15	0.41	5.08	9.54	204	55	3	16872.739
Tanana	Yukon-Koyukuk (CA)	0.74	0.26	3.38	13.42	227	242	3	34421.175
Tatitlek	Valdez-Cordova (CA)	0.67	0.42	3.10	9.93	302	92	3	42664.902
Teller	Nome (CA)	0.71	0.20	4.43	11.35	325	253	4	26611.329
Tenakee Springs	Hoonah-Angoon (CA)	0.64	0.30	3.58	12.80	166	129	2	38326.098
Tetlin	Southeast Fairbanks (CA)	0.33	0.17	2.11		334	126	4*	42544*
Thorne Bay	Prince of Wales-Hyder (CA)	0.21	0.16	2.85	13.41	402	442	3	52788.777
Togiak	Dillingham (CA)	0.61	0.18	3.90	13.16	410	808	4	27741.732
Tok	Southeast Fairbanks (CA)	0.33	0.17	2.22	14.12	469	1,218	3*	55122.29*
Toksook Bay	Bethel (CA)	0.55	0.18	4.03	14.45	446	601	5	34951.088
Tuluksak	Bethel (CA)	0.61	0.24	4.38	13.20	244	365	5	36518.842
Tuntutuliak	Bethel (CA)								29503.864

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		0.65	0.26	3.60	13.50	357	380	4	
Tununak	Bethel (CA)	0.55	0.18	4.03		388	318	4	28925.357
Twin Hills	Dillingham (CA)	0.56	0.16	5.73	7.44	328	78	3	33987.295
Unalakleet	Nome (CA)	0.48	0.19	3.61	13.48	444	685	3	48690.633
Unalaska	Aleutians West (CA)	0.33	0.24	2.04	13.70	483	4,092	3	80457.617
Wainwright	North Slope	0.17	0.15	4.40	12.43	644	536	4	63314.136
Wales	Nome (CA)	0.67	0.19	4.07	12.56	362	153	3	38566.757
Whale Pass	Prince of Wales-Hyder (CA)	0.47	0.21	2.14	12.34	208	37	2*	43714.12*
White Mountain	Nome (CA)	0.92	0.50	3.01	9.57	296	209	3	29889.15
Yakutat	Yakutat	0.46	0.24	3.10	13.38	446	742	3	54132.071